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Contents

Mammoth Spring Hydroelectric Plant—By E. C. Bellamy . . 144

Low-Head Water-Power Plant Constructed by Mammoth Spring Electric Light & Power Company Combines Efficiency with Esthetic Appearance.

Electricity in the Manufacture of Gears 146

Electric Motor Drive is Being Successfully Employed in Two Large Gear-Manufacturing Plants which Are Fully Described—Tabulated Motor Data Are Given for Each Installation.

Co-Operative 14 Months Appliance Campaign 152

Complete Details of a Comprehensive Sales Effort Inaugurated by the Pacific Gas & Electric Company Which is Participated in by All Local Dealers.

Planning a Power Sales Campaign—By Thomas R. Hay . . 155

Details of Methods for Organizing a Power Bureau and Systematically Securing Industrial Power Business, as Carried Out by the Duquesne Light Company, of Pittsburgh.

Editorials:

Tendencies in Large Generating Units....136
Electrolysis from Stray Currents....136
Co-operation in America and England....137
The Future of Copper....138
Universal Electricity Supply and the Conservation Movement....138

Happenings in the Industry:

Theory of Impulse Currents....139
Annual Meeting of Western Society of Engineers....139
Engineers' Club of Springfield Elects New Officers....140
Flood Lighting Discussed by Chicago Illuminating Engineers....141
Illinois Contractors to Meet Next Week....142
Electrical Contractors' Association of Wisconsin Holds Meeting....142
Missouri Contractors Elect Officers....145

Commercial Practice:

Demonstrations of Electrical Appliances Made for Benefit of Housewives and Maids....151
A "Wireless" Sign Attracts Attention in Springfield Window....151
S. V. Walton....154
Increasing Business Makes Plant Extensions Necessary at Joplin....154

Power Engineering:

Industrial Heating Contract Secured in Chicago....157
Convenience of Electric Heating....157

Electrical Construction:

Electrical Construction at Crane Plant, Chicago....158
Important Questions to the Electrical Contractor.—By G. W. Hill....162

National Association of Electrical Inspectors....163
Conduit Evolution—I—By Alfred E. Braddell..164
Public Service Commissions....166
New Appliances....168
Industry Activities....174
Current Electrical News....176
Record of Electrical Patents....179

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EDITORIALS

TENDENCIES IN LARGE GENERATING UNITS.

A few years ago an electrical generating unit of 10,000 kilowatts was regarded as extremely large and one does not have to go back a great many years to find a 5,000-kilowatt unit the largest in operation. The first mentioned unit was, however, soon followed by one having a capacity of 20,000 kilowatts and in recent years the increase quickly stepped up to 30,000 and 35,000 kilowatts, the latter representing the largest unit which is now in operation anywhere in the world. Consideration is being given, however, to units as large as 50,000 kilowatts and it is not unlikely that a machine of this rating will become a realization in the near future. It must be remembered, however, that better steam consumption can be secured by an arrangement utilizing two machines running at different speeds and using in succession the same steam flow. A combination of two turbine generating units of this type aggregating in capacity 47,000 kilowatts is already under construction.

The possibilities of short-circuits in machines of such large capacities require very serious consideration and the greatest protection which can be secured must be provided. The armature reaction is run as high as is feasible and the coils are sunk deep in the slots. The result is a large internal reactance in the generator and this tends to reduce the instantaneous current in case of short-circuit. Means must also be taken to secure the stator coils, so they will not be distorted in case a short-circuit should occur.

In connection with the electrification of steam railroads, there has been a demand for large single-phase turbogenerators operating at 25 cycles. In spite of the difficult problem of building a machine of large rating with two poles and supplying suitable conducting material in the rotor to damp out the pulsation of flux which arises from the pulsation of armature reaction, a number of such machines of large capacity have been constructed. Among these are the machines supplying the Norfolk and Western Railway, which has an electrified section over the mountains at Bluefield, W. Va. The largest units of this type which have yet been constructed are those which were installed last fall by the New York Edison Company for supplying power to the western end of the New York, New Haven and Hartford Railroad. These units are really 20,000-kilowatt, three-phase machines, but single-phase current is used from them. The single-phase capacity of each of the two units, operating at 70-per-cent power-factor, is 14,300 kilovolt-amperes. As the size of the generator increases it becomes an exceedingly difficult matter to laminate conductors in the stator sufficiently well to prevent excessive loss from the eddy currents.

The designers of large machines have had a number of difficult problems to work out in this connection, and those who are unfamiliar with developments in this line will hardly realize or properly appraise the genius of the men who have been responsible for these developments.

ELECTROLYSIS FROM STRAY CURRENTS.

The electrolysis of underground metal structures, such as pipe systems and cable sheaths, has led to serious damage in many cases, and greater trouble seems to have been experienced in this country than elsewhere from this cause. The trouble has been attributed largely to the use in this country very generally of the overhead trolley with direct current for street-railway propulsion, and the lack of measures for preventing the return currents, which are supposed to flow to the power house through the tracks, from taking a path through the earth or conducting bodies embedded in it. For several years the Bureau of Standards has been making a study of this problem and its officials have been called upon to make investigations and give advice in many cities where trouble has been encountered. Several publications have been issued by the Bureau on different phases of this subject, and another has been lately issued summarizing the entire subject of electrolysis and its mitigation.

The conclusions given in this report are worthy of consideration in detail by electric utilities and others concerned with such cases of electrolysis. The study of the subject has been extensive and the conclusions reached are based upon observations in a large number of cases, experimental investigations carried on at the laboratories of the Bureau, and an exhaustive study of previous publications concerned with this important subject.

Of the various remedies which have been proposed for electrolysis mitigation it is found that few can be depended upon to give satisfactory results and that none can be used indiscriminately if the best results are to be secured. The use of pipe coatings, such as paint or wrappings, in protecting a metal structure, is found not to be dependable in giving protection. This practice is likely to concentrate electrolytic action at particular points where it may reach serious proportions. Wrappings have been found better than paint for this purpose, but it is recommended that this remedy be applied only in areas where the current is entering the pipes, commonly designated as negative areas.

The insulation of pipe joints is often a useful auxiliary of other methods of preventing electrolysis, but should not be depended upon alone to entirely obviate trouble.

Systems of pipe drainage, by which is meant the provision of a metallic conductor between the pipe system and the power house, have been widely used and are also valuable as accessories. The method has, however, a number of objections, as the protection is not likely to be permanent, it is likely to increase the amount of current carried by the pipes, and its application to one pipe system may endanger others. The draining of lead-covered cables is found to be more advantageous than the draining of pipe systems. All such methods, however, are an attack upon the symptoms of the disease and are not aimed at the source of the trouble. The trouble in most cases is due to the provision of an insufficient return path to the power house for the railway currents, and trouble can best be obviated by making provision of a suitable return. This involves proper track construction, bonding and cross-bonding of rails, and the use of additional return circuits in the form of negative feeders. It has been demonstrated that such feeders, whether used with or without boosters, are much more efficient when insulated than when not insulated, and the report emphatically advocates the use of insulated negative feeders.

Another method of mitigation which has been little used in this country, but has been applied in Nuremburg, Germany, for a number of years, is a three-wire system of supply to the railway. This has recently been applied to at least two American street railway systems, the latest of which is at Springfield, Mass., as reported in our issue of January 1. In this system, alternate sections of the trolley are fed from the positive busbar, the intermediate sections being fed from the negative busbar. The tracks and any feeders paralleling them constitute the neutral conductor, which has to convey to the power station only so much current as is represented by the unbalance of the positive and negative sections. In the case of a double-track railway, one track may be fed from the positive side and one from the negative.

The three-wire method is simple in application and greatly decreases the amount of current flowing in the earth return. It is reported to have given operating trouble when first applied in this country, but its recent application in Los Angeles and Springfield would indicate that the officials of the companies in these two cities have faith that these troubles can be overcome. It involves insulation for double voltage between adjacent sections of trolley wire, but otherwise the insulation problem is no different than under the ordinary method. If regulations limiting the permissible voltage drop in track-return systems become widely adopted, the three-wire method would seem to offer a cheaper solution of the difficulty than would the investment in large quantities of copper for improving the resistance of return circuits.

CO-OPERATION IN AMERICA AND IN ENGLAND.

Complaints are frequently heard of the lack of co-operation not only among the different branches of the electrical industry in this country, but among the individuals of the same branch. It is said that there is too much talk about co-operation and too little action. At times this appears to be true, but a review covering any considerable period of time will disclose many instances of practical and successful co-operation. The situation in this respect is far better than in England, where the prevalent ideas of extreme individualism make it difficult to initiate any concerted and organized movement for the general good. There it is every fellow for himself and the devil take the hindmost. In this respect we occupy an intermediate position between the British and German extremes, for it must be admitted that in organization and co-operative efficiency Germany leads the world. This is evidenced not only in industry, but in municipal affairs, military action, etc. Indeed, if we are not to be forced in the struggle for existence into an equally efficient socialism of either the democratic or paternal variety, with the resultant danger of suppressing initiative and originality, it behooves us to inaugurate a social and industrial system founded on the individualistic ideal which does not base one man's success upon another's failure or loss. With an equitable distribution of the products of industry, greater productiveness on the part of any individual or group would mean greater prosperity for others as well as himself. Similarly between nations, greater efficiency in one would be welcomed instead of feared by another. Fighting between commercial nations which should mutually benefit by trade is an anomalous condition. What Great Britain needs more than the crushing of Germany is a new industrial system—regeneration from within.

That the chaotic state of affairs which exists in England with respect to any mutual co-operation in electrical matters is recognized at home has long been evident in the columns of its electrical journals. The postion has never been better painted, however, than by a writer in the last 1915 issue of *Electrical Industries and Investments,* who has penned a clever satire supposedly taken from the columns of the same journal ten years in the future. A presidential address before the Institution of Electrical Engineers, a speech by the president of the Board of Trade, reports of meetings of a municipal corporation and of the Electrical Contractors' Association, all indicate an inability to get together and co-operate, as well as an inability to grasp and solve the problems confronting the industry. While congratulating this anonymous writer upon his effort, we must offer condolence to our British brethren, and express our thankfulness that we have made at least some progress in these matters at home.

THE FUTURE OF COPPER.

In discussing last week the probable extension of the use of aluminum for electrical purposes and especially in transmission lines, we referred to the likelihood of the exhaustion of the present sources of supply of copper about a generation hence. It may be of interest at this time to consider in more detail the present status of copper in the industry and what may be expected of it in the near future. Unfortunately complete information is not available as to the present visible supply of copper ore, but partial estimates have been made which will shed some light upon the world's resources.

An estimate made in 1911 of the ore reserves in the Lake Superior district indicated recoverable copper from mines now in operation amounting to over 1,000,000 tons. Similar estimates for the Anaconda district and certain other large producers are not available. But a survey of other sources, including several of the largest mines in this country, indicated a visible supply of 10,000,000 tons. For foreign mines even less authentic data are available, but a partial list of these indicates another 10,000,000 tons of copper. It is thus evident that at the present rate of consumption of about 1,000,000 tons per annum the present visible supply would last considerably longer than twenty years. Account should be taken, however, of the fact that the annual consumption shows a tendency to greatly increase.

At the present time the United States produces more than half of the total copper output of the world. Of the world's production it is estimated that 60 to 70 per cent is used in the electrical industry in normal times. Some of the items which go to make up this total may be of interest. It has been estimated that the telephone and telegraph systems of the world have used about 600,000 tons of copper, 60 per cent of which is charged against the United States. In addition to this, submarine cables have required about 10,000 tons. The annual increase for telegraph and telephone business is over 40,000 tons. Excluding private plants, it has been estimated that electric railway, lighting and power plants in this country have absorbed a total of about 50,000 tons of copper.

Consumption of copper has increased at an extraordinarily rapid rate and this tendency may be expected to continue in the future. For some time it may be expected that ordinary supply and demand rather than an approach to exhaustion of ore reserves will control the market price of this metal. However, as the mines now producing the greatest supply approach exhaustion, a rise in price will probably occur. This should result in making profitable the working of mines which are not at present in operation and also in the search for new ore deposits. It is expected that large deposits of ore may be found in the Congo district of Africa and in China. The opening of such ore bodies would, of course, delay the rapid advance in price, so that it is likely that more than a generation will pass before we experience an actual scarcity of copper. At the present time Japan is the next largest producer to the United States, while still smaller outputs are reported from Russia, Australia, and Spain. North and South America together produce at present about 73 per cent of the world's supply. Before an actual scarcity is felt, however, as pointed out last week, the metal will probably be suffiicently valuable in comparison with aluminum to bring about a general substitution of the latter for those purposes where it is most suitable, such as transmission lines and busbars.

UNIVERSAL ELECTRICITY SUPPLY AND THE CONSERVATION MOVEMENT.

A very marked tendency in the electrical industry in the last ten or more years has been the gradual electrification of power production coincident with the consolidation and extension of central-station electrical supply systems. This has been in accord with the economic necessities of the times. On looking into the economic necessities of the future there has arisen the need for active measures to promote the conservation of our natural resources and the agitation of this subject has been successful at least in emphasizing its importance. The close relation between these two movements was not at once apparent and it is only recently that this has been very strikingly pointed out.

In an address delivered last week before the Western Society of Engineers, which is briefly reported in another part of this issue, and in a similar address in Boston during the preceding week, Mr. Samuel Insull disclosed some very striking figures on the economics of universal electricity supply and its effect in conserving coal and other resources. If the steam railroads and all isolated and manufacturing plants of Chicago were electrified and had their electrical energy supplied from the central-station system, Mr. Insull said that the coal consumption for the consolidated load would be 6,000,000 tons a year as against 11,000,000 tons if the energy production remained independent and isolated as at present.

A study of the entire country showed that there would result from the consolidation of the energy supply to the railroads, industrial and commercial plants, and the present central-station networks an annual saving of some 250,000,000 tons of coal; in other words, the coal used for these three principal classes of power users would be reduced by about 45 per cent. The value of this fuel saving would amount to between $500,000,000 and $625,000,000 a year.

Other elements of conservation resulting would be the release of capital now tied up in isolated and other small energy-producing plants, reduction in the cost of living due to practical elimination of smoke with its resultant need for frequent washing and cleaning, reduction of cost of manufacture, improved housing and living conditions, and in general a marked conservation of human health and happiness.

Happenings in the Industry

Theory of Impulse Currents Discussed by American Institute—Western Society of Engineers Elects Officers—Samuel Insull Discusses Universal Electrical Supply—Flood Lighting Gaining Prominence—Wisconsin Contractors Meet at Milwaukee—Annual Meeting of Northern White Cedar Association—Edison Banqueted by Ohio Society

THEORY OF IMPULSE CURRENTS.

The Monthly Meeting of the American Institute of Electrical Engineers.

The 317th meeting of the American Institute of Electrical Engineers was held in the Engineering Societies Building, New York City, on Friday evening, January 14, with President J. J. Carty in the chair.

A paper was presented by Charles P. Steinmetz entitled "Outline of Theory of Impulse Currents." This paper started out with the differential equations which apply to a circuit in which the resistance, shunted conductance, inductance and capacity are constant and from these developed the general equations which apply to all circuits coming within this category. Special cases were then taken up. These included continuous currents, alternating currents, impulse currents and general transients. Continuous currents represent a limiting case. While the alternating currents are the useful currents of our electric systems, the impulse currents may be said to be the harmful currents, since many disturbances and troubles are caused by them. Circuits with massed constants, continuous circuits with distributed constants and alternating-current circuits with distributed constants were first considered, but the larger part of the paper was devoted to impulse currents, to which but little systematic study has heretofore been given.

The values of the constants which occur in the fundamental equations, which characterize impulse currents, were first considered. These constants are designated as the energy-transfer constant, the energy-dissipation constant and the distortion constant of the circuit. Two classes of impulse currents were considered, periodic and non-periodic. Equations for the current and the voltage in terms of the electrical characteristics of the circuit were worked out for each case.

The discussion was opened by Michael I. Pupin, who differed with Dr. Steinmetz in his point of view of some of the phenomena concerned. Impulse currents form the basis of the two great early electrical arts, telegraphy and telephony. He referred to the work of Lord Kelvin and Kirchhoff, who had worked out complete solutions for the cases of the submarine cable and the overhead line, respectively. He regarded Kirchhoff's publication in 1858, which utilized Fourier's series, as the most beautiful work in the mathematical theory of electricity which had ever been performed. Telephony, as well as telegraphy, deals with impulse currents, and not with alternating currents, since articulation does not represent a sustained frequency, but a mixing of various overtones in short impulses. He pointed out that the equations of Dr. Steinmetz do not cover all cases, since the electrical constants of the circuits are sometimes variables. These equations are, however, a useful foundation for working out many problems. He referred to the oscillating arc, in which there is a variable resistance, and the oscillation in a vacuum tube, which is due to something else. In a single-phase induction motor there is a variable mutual inductance, which may result in the production of oscillations. When the capacity has the proper value such oscillations may result in large currents which may ruin the machine or bring it to a standstill.

Harold Pender pointed out that the impulse current of the paper was what is usually called a transient current. He regretted that the author had not given more physical interpretation of the integrated equations. He referred to the complications arising when mutual inductance exists between two or more circuits.

D. B. Rushmore pointed out the relation between theoretical investigation and commercial work.

Hans Lippelt cited the case of an open-coil direct-current machine as one in which the constants of the circuit are variable, hence one to which the equations of the paper do not apply.

In closing the discussion, Dr. Steinmetz pointed out the limitations of the equations which had been worked out. He used the term impulse currents to mean a certain class of transients which are characterized by being non-periodic. They thus differ from oscillating currents, which are alternating currents of diminishing amplitude. The work referred to by Professor Pupin represented special cases.

During the course of the evening President Carty was called from the room to speak over the telephone to a meeting of the Boston Section which was being held the same evening in Boston.

In place of the usual monthly meeting in February, the midwinter convention will be held in New York City on February 8 and 9 These dates were decided upon in cooperation with the Illuminating Engineering Society, which will hold a convention on February 10 and 11 in the same building. It is expected that this arrangement will be of convenience to the members of either society who desire to attend both conventions.

ANNUAL MEETING OF THE WESTERN SOCIETY OF ENGINEERS.

Address by Mr. Insull on Universal Electricity Supply.

The forty-sixth annual dinner and meeting of the Western Society of Engineers was held at the Hotel Sherman, Chicago, on the evening of January 12. During the dinner music was provided by the Commonwealth Edison Orchestra and by the Peoples Gas Company Choral Society. Edwin H. Lewis acted as toastmaster.

A brief report was presented by Acting-Secretary E. N. Layfield covering the more important activities of the Society during the past year. The membership is now 1,228. The Octave Chanute medals, which are annually awarded to members who have presented the best papers in civil engineering, mechanical engineering and electrical engineering during the preceding year, were awarded, respectively, to N. M. Stineman, H. E. Goldberg and Andrew Allen.

President William B. Jackson then made his retiring address, in which he first paid a tribute to the late secretary, J. H. Warder. He reviewed some of the work accomplished during his administration, particularly the appointment of the two very important committees on Public Relations and Engineering Ethics; the latter committee has drafted, after very careful study, a code of engineering ethics which will be presented to the consideration of the Society in the near future. Mr. Jackson referred to the offer made by Past-president John W. Alvord of $1,000 in interest-paying securities, which is to be used as a fund

the income from which will be used in an annual award to the engineer who has accomplished some notable engineering achievement for the public good. This fund has been accepted by the Society, and a committee appointed to draw up the details respecting this award.

Newly Elected Officers.

Mr. Jackson then announced the results of the election of officers as follows:

President, Bertrand E. Grant.
First vice-president, Charles H. Cartlidge.
Second vice-president, Denney C. Roper.
Third vice-president, Frederick H. Newell.
Treasurer, Carlton R. Dart.
Trustee, Ernest McCullough.

On assuming the chair, Mr. Grant made a brief address in which he referred to the organization of the Western Society of Engineers, in May, 1869, and reviewed some of the early history of the Society. He called attention to the many important engineering works that have been executed by its members.

Mr. Insull's Address.

The principal address of the evening was delivered by Samuel Insull, president of the Commonwealth Edison Company, Chicago, on the subject "Universal Electricity Supply." The experimental central station developed by Edison at Menlo Park, N. J., in 1881, was referred to. This contained all of the important elements of the modern central station.

Taking up the main theme of his address, Mr. Insull spoke of the erection by Ferranti of the first central station using alternating-current generation and distribution. This was at Deptford, London, and in Mr. Insull's opinion was the earliest conception of a system permitting universal supply of electrical energy. He then referred to Ferranti's address as president of the Institution of Electrical Engineers in 1910, when he proposed the generation of electrical energy by large units located at the mines and the transmission of the energy to present plants, where it would be converted to suitable form for its distribution over the present distributing networks. A few years later in an address before the Franklin Institute, Charles P. Steinmetz predicted that there would be developed in the near future great electrical supply systems providing universal energy supply over extensive areas. Mr. Insull referred to his own various talks on this subject, and confessed that it had become a hobby of his.

Citing the United States census figures of 1912, he showed that as yet only a small part of the energy supply of the country comes from centralized plants. He called attention to the improvement in the efficiency of electricity production in recent years. It is now possible in large stations to obtain an average of about 17 per cent of the energy of the fuel delivered at the switchboard. He predicted that during the next few years improvements in steam and generating equipment would doubtless raise this to between 20 and 25 per cent.

When one considers these figures carefully an extraordinary gain is evident from the mass production of electrical energy compared with the wasteful methods used in small plants. This economic gain has many aspects, of which the conservation of fuel is one of the most important. This improved economy in energy production is attainable only through generation in very large units and distribution of the energy over unified transmission and distributing networks. He compared the energy production in the 69 central stations that supply Greater London with the energy supply from one central station in Chicago. The output of the latter is very much greater and the energy is produced much more cheaply in Chicago. This is a very emphatic example of the economy of centralized production.

Mr. Insull referred to the recent report of the Chicago Commission on Smoke Abatement and Railroad Electrification. Based on the data of that report he had figures prepared to show the economy resulting from the complete electrification of the entire city of Chicago and suburban district. If all of the manufacturing and isolated plants, and all of the steam railroads in this territory were electrified, the total coincident demand would be about 577,000 kilowatts. If all of this energy were supplied from one central station system there would result a saving of 150,000 kilowatts in generating capacity through the diversity-factor obtained by supplying the various classes from one system. There would also result an improvement in load-factor of the Chicago central station from 40 to about 50 per cent. If the three classes, that is, the present central-station load, all present isolated and manufacturing plants, and the steam railroads, were operated separately as they do now they would require about 11,000,000 tons of coal per year as compared with 6,000,000 tons of coal annually if all the energy production had been centralized. This comparison shows the extraordinary conservation of our coal resources which results from the monopoly supply of electricity.

Mr. Insull made a similar study of the complete electrification of all energy production of the entire country. The steam railroads of this country now use about 135,000,000 tons of coal annually. If all of the three classes of load above referred to were electrically supplied from a unified or co-ordinated electrical system throughout the country, the maximum horsepower required would be 30,000,000, as against 43,000,000 horsepower if the three classes of load remained as they do now. Assuming an investment of $200 per horsepower in the generating plant, the amount of capital released by such unified energy production would be tremendous, running into the billions of dollars. Estimates prepared showed that in 1925 such a unified energy production would mean the saving of 250,000,000 tons of coal annually, or billing this at $2.50 a ton, a saving of $625,000,000 a year in this one item alone. In these comparisons many other loads were not included, such as power for water pumping, drainage, etc., which, had they been included in the estimates, would have increased the savings about 25 per cent.

In conclusion, Mr. Insull declared emphatically that the economics of centralized energy supply were so clear that it is bound to be developed and brought about in the not distant future. He spoke of the restrictions of regulatory bodies and other obstacles which have been met in the carrying out of the idea of universal electric service. In the West, where fuel is expensive and water power available, these obstacles have been brushed aside. The time is coming when it will be realized that, if we wish to conserve our resources both in fuel and in capital, if we wish to secure the lowest cost of manufacture, provide energy to the most humble citizen of the community, it will be necessary to marshal the production and distribution of energy in a unified system, and this is bound to come regardless of whether it will be done by private or public capital.

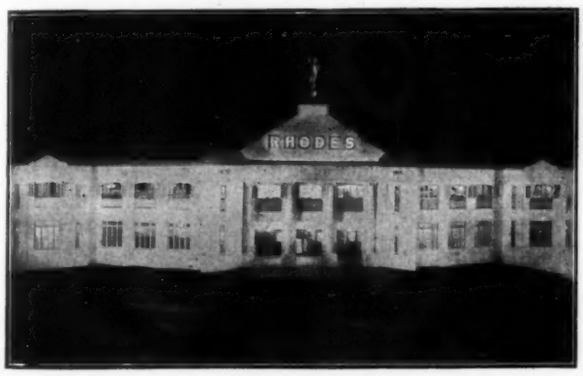
Engineers' Club of Springfield Elects New Officers.

The Springfield (Ill.) Engineers' Club has entered upon the second year's work of the organization by electing Clifford Older, bridge engineer for the Illinois State Highway Commission, president; H. B. Lewis of the Central Union Telephone Company, recording secretary, and J. R. Hughes of the State Public Utilities Commission, corresponding secretary. The club has an active membership of 130.

Flood Lighting Discussed by Chicago Illuminating Engineers.

At a meeting of the Chicago Section of the Illuminating Engineering Society held on the evening of January 13 in the Edison Building, Chicago, James R. Cravath gave an illustrated talk on "The Exterior Lighting of Buildings." The possibilities in making the exterior of buildings attractive at night have been indicated by the developments in outdoor lighting at the several great national and international expositions held in this country since 1893. The Chicago World's Fair in 1893 was the first installation in which outline lighting was used extensively. At the Pan-American Exposition, at Buffalo, in 1901, flood lighting was used for the first time in the illumination of the tower. At the St. Louis Exposition of 1904 further developments occurred, but it was not until the Panama-Pacific International Exposition in San Francisco last year that flood lighting came into its own; there it was used almost exclusively for the exterior lighting of buildings, statuary, etc., and demonstrated on a grand scale and to an extent hitherto unknown the great possibilities of this particular method of lighting.

Mr. Cravath said that the general trend of exterior lighting has been, just as in the case of interior lighting, to get away more and more from glare, this being particularly necessitated of late through the development of high-power and high-efficiency units. Outline lighting has in general been quite successful as a means of advertising or spectacular lighting, but it is comparatively expensive on account of the elaborate wiring and large number of lamps required.



Flood Lighting of Rhodes Casino, Providence, R. I.

Flood lighting has become very popular during the past year or so, because of the novel effects it is possible to produce thereby. Other features making it distinctive are that it is free from glare, can be operated at relatively low cost and trouble, permits lighting with the new gas-filled tungsten lamps, which are much more easily controlled than arc lamps, and lights the entire building front instead of only parts thereof. In general flood lighting is done by projector lamps placed at a distance from the building or in some instances by reflector equipment mounted on the building itself, or special equipment installed in lamp posts closely adjoining the building.

Several typical installations of flood lighting were shown and described.

Mr. Cravath pointed out that the efficiency of projectors depends on the amount of light flux intercepted by the reflector, and on the efficiency of the reflector itself. From tests he had made he had found that the maximum efficiency in the light beam as yet attained is about 47 per cent, that is, about that percentage of the total light flux developed by the lamp is projected in a concentrated beam. In the placing of equipment for flood lighting on buildings across the street from those to be illuminated care must be used so that the direct light from the projectors does not annoy pedestrians passing the building

Demonstrations were made of several types of projectors for flood lighting by representatives of the National X-Ray Reflector Company, General Electric Company, and American Lighting Company.

In opening the discussion, Acting-chairman M. G. Lloyd called attention to the great variety of applications of flood lighting, which is finding new uses almost every day. F. A. Vaughn referred to the lighting of a large sign in front of the Merrill Theater, Milwaukee. This sign is studded with jewels, and lighted through projector lamps in which a color effect was ingeniously produced. In the main entrance of this theater a rainbow-like effect was produced from one white reflector and three colored units; the color was gradually changed in three-minute cycles through motor-driven dimmers which controlled the relative amount of light projected by the different units. The bulletin boards were also illuminated by means of small flood lamps. In the new street-lighting installation of Milwaukee an effort is being made to light the fronts of buildings in the downtown district by mounting the lamps at a height of 30 feet above the street.

J. A. Hoeveler showed views of and described the flood lighting of the Rhodes Casino in Providence, R. I. C. A. Luther said that an objection to flood lighting of commercial buildings by means of projectors located on adjoining or opposite buildings is the difficulty of obtaining consent to mount the equipment there. The installation at the store of Klee Brothers, Chicago, which Mr. Cravath had described and which was first described and illustrated in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of October 16, 1915, gave Mr. Luther a suggestion that similar results could be obtained by the use of gas lamps, and he looked forward to important developments in that line.

Albert Scheible believed that the development of flood lighting will react on architecture by bringing about the selection of material for use in building fronts that is especially adaptable to effective lighting at night, and which can be easily kept clean. Another important development is in the possibility opened up of producing color effects on a building front.

A. L. Arenberg had found one installation where the exterior of the building was flood-lighted in which it was necessary to pull the blinds in the offices to prevent serious glare from the brilliant lamps which were directly opposite the windows. J. Stair had found on the contrary that in the case of the First National Bank in Cleveland that the light thrown into the interior was not found objectionable. L. Friedmann stated that it is not always necessary to mount the reflectors or projectors on buildings across the street. It is frequently possible to use a part of the building being illuminated for this purpose, or the projector equipment may be placed very close to the building. F. H. Bernhard called attention to the fact that in carefully designed flood-lighting installations the effect of electric signs and of store-window lighting is not spoiled by the superposition of flood lighting. On the contrary, it is possible to produce a very harmonious result.

J. B. Jackson then described at length the series of experiments that has been made on the proposed lighting of the Edison Building, Chicago. A large number of systems have been tried out and the work is in charge of a committee which has decided on some of the important features, but others have not yet been approved. This building is over 30 stories high; opposite one of its fronts is the Federal Building, and obtaining consent to mount projectors on this was out of the question; opposite the other front is a 12-story building which might have been used

for this purpose but the projectors mounted on the roof of this structure would not have given a uniform lighting of that front. Tests were made at lighting from a building diagonally opposite without complete success. Many other difficulties were met. The scheme proposed is to use a combination of outline and flood lighting, there being three or four rows of lamps at different levels for outline effect and two rows of projector lamps mounted on ledges of the building at the second and fourth floor levers for flood lighting. Only part of the equipment is as yet installed, but it is believed that when the installation is completed it will be a very noteworthy one because of the very difficult problem involved in the effective lighting of this building. G. W. Baker spoke of some of the preliminary tests and methods used to overcome the difficulties in the selection of proper units for this purpose. He also described the projector lamps specially designed for this installation. R. E. Powell also explained some of the difficulties met in the attempt to light the building from other buildings nearby. It was found that the beam from the projectors was very noticeable on account of dust and smoke in the air.

Other uses for flood lighting were spoken of by Charles Starr and H. Schaedlich. Mr. Starr called attention to its use in aiding construction work at night where it has been found not only very successful, but extremely economical compared with former methods. It also has been used with much success in permitting ice harvesting at night. Mr. Schaedlich spoke of the trial installation of flood lighting at the Clarendon Municipal Beach, Chicago. In the permanent installation which will be put in this spring it is proposed to light this extensive beach from two 75-foot towers placed at the north and south ends of the beach. The area lighted will be 800 feet along the shore and extend outward into the lake about 500 feet. Flood lighting is also being used successfully for the lighting of a number of playgrounds, particularly those adjoining school buildings, in which case the projectors are located on top of the buildings about 60 feet above ground.

Illinois Contractors to Meet Next Week.

The regular semi-annual meeting of the Electrical Contractors' Association of the State of Illinois will be held at the Sherman Hotel, Chicago, on Thursday and Friday, January 27 and 28. An open session will be held in the morning of each day and a closed session in the afternoon. Among the speakers will be W. W. Low, of the Electric Appliance Company.

On Thursday afternoon there will be a theater party for visiting ladies and on Friday evening the usual banquet will be held. On Saturday it is proposed that the members will attend the Automobile Show which will be held at the Coliseum during the week.

Carrying Capacities for Transient Currents—A Correction.

On page 55 of the issue of Januay 8 an abstract was given of a paper by Frank C. Wagner on carrying capacities of wires for transient currents. An error occurred in the formula giving the time necessary for fusion in different cases. This should read $t=K^2F/I^2$, where t is the time in seconds, I is the current in amperes, F has a value depending on the metal, and K is the cross-section in square centimeters.

Storage-Battery Traction Line for Connecticut.

Plans for a storage battery electric line between New Britain and Meriden, Conn., are being brought to a head by representatives of the Chambers of Commerce of the two cities and a storage-battery company. It is estimated that the road and equipment will cost about $150,000.

Electrical Contractors' Association of Wisconsin Holds Meeting.

The thirteenth annual meeting of the Electrical Contractors' Association of Wisconsin was held in Milwaukee at the Hotel Wisconsin, January 17, 18 and 19.

The first business session was called to order by President L. W. Burch of Madison at 2:30 p. m., January 17. The most important matter discussed and acted upon at this session, was that new blood in the form of additional members is needed, and that a determined effort be made to get them.

B. Berssenbrugge, electrical inspector of the city of Milwaukee, then gave an interesting talk, outlining his experiences in "Enforcing the Code." He began with a brief history of how his department was created.

This brought out the fact that the Electrical Contractors' Association of Wisconsin was the prime mover in bringing about the licensing of electrical contractors and municipal inspectors in Milwaukee, as the association as far back as 1907 began working thereon, through the Legislature at Madison. Although this department's inspection is considered final the Board of Underwriters (now termed Wisconsin Inspection Bureau) also inspects, without fee, all work they are notified on, or where their interests warrant. This means considerable "dual inspection," which is more or less of a nuisance.

H. L. Geisler opened the morning session on January 18 with a paper on "Liability Insurance." Mr. Geisler's paper gave a clear statement of costs and other interesting information on this subject that is or should be included in the contractor's overhead expense account.

O. E. Rhuoff substituting for Prof. Chas. F. Burgess of the French Carbon & Battery Company, Madison, followed with a 30-minute paper on "Dry Batteries." Prof. Burgess' paper was decidedly interesting and instructive.

At 2 p. m. L. L. Tatum of the Cutler-Hammer Manufacturing Company began the open session with a talk on "Remote Control of Electrical Apparatus."

Mr. Tatum presented a very complete discussion covering remote control apparatus in detail.

L. F. Meissner Jr., of the Edison Storage Battery Company, Chicago, followed with a talk on "Storage Batteries."

Beginning with a brief non-technical history of storage batteries in general, Mr. Meissner later interestingly explained the construction and general make-up of Edison storage batteries.

Henry A. Morss, vice-president of the Simplex Wire & Cable Company followed with a paper on "The Manufacture of Insulated Wires and Cables" which was illustrated with motion-pictures and lantern slides.

Discussion more or less spirited was indulged in after most of the subjects presented, so if discussion, "makes for knowledge and wise decision," those attending surely profited.

The informal dinner at 6:30 p. m. was attended by 54 person, many of whom were jobers, manufacturers or their representatives.

Many interesting talks, some serious, some humorous, were given by M. B. Austin, H. A. Morss, H. L. Geisler, W. F. Patton and J. B. McMullin, they having been called upon for a few words by President L. W. Burch, who acted as toastmaster.

The closing sessions were held January 19, during which officers as follows were elected for the ensuing year:

President, F. J. Natwick, Grand Rapids.

Vice-president, Paul Honold, Sheboygan.

Treasurer, George Knoerr.

Secretary, Albert Petermann, Milwaukee.

Director for three years, B. L. Burdick, W. R. Johnson, Wausaw, holding over 2 years and Paul F. Harloff, Madison, holding over one year.

Herman Andrae was elected director to the National Association.

Annual Meeting of Northern White Cedar Association Held at Minneapolis.

Considerable attention was given the matter of publicity at the twentieth annual meeting of the Northern White Cedar Association which was held at the Hotel Radisson, Minneapolis, January 13 and 14. In the presidential address, L. A. Page, Jr., called attention to the campaign which is just being inaugurated and to the benefit which is expected. It was announced that the Western Red Cedarmen's Association had decided to spend $5,000 on a campaign to increase the use of their product and as this field is identical with the Northern White Cedar field, it was thought best to carry on a co-operative campaign, thus gaining economy for both Associations.

The report of the secretary reviewed the activities of the Association during the past year. Special attention was called to exhibits which were participated in by Northern white cedar producers, and to a suggestion that the State of Minnesota should, in line with adjoining states, maintain a department to investigate its natural woods, with a view toward determining the length of life of different woods under various conditions of service and treatment.

H. F. Partridge,
President-elect, Northern White Cedar Association.

Mr. Partridge, who is one of the most popular members of the Association, was born in New York in 1875. He moved west in 1892 and for eight years thereafter was connected with the wholesale lumber business. In 1900 Mr. Partridge with his brother T. M. Partridge organized the T. M. Partridge Lumber Company, of Minneapolis, at present one of the largest producers of cedar poles, with yards at various points in the Northwest. Mr. Partridge has been one of the most active members of the Association for the past 10 years and last year served as vice-president.

The Insurance Committee explained the desirability of blanket insurance which has been generally in effect among producers of lumber and had proven very satisfactory in their business and was desired over other forms of insurance. Because of reduction of rates by recent legislation the situation in Minnesota and Michigan has grown very favorable. The Railroad Committee reported that during the year many readjustments of rates had been sought and secured.

The annual banquet was held on January 13, there being present 60 guests, who displayed the usual spirit of good fellowship which characterizes the banquets of this organization.

Considerable discussion took place on the second day of the convention relative to ascertaining the cost of producing various cedar products, a committee having been appointed to collect such data. The committee reported that much difficulty was being encountered because of variable costs incident to diversified operations.

The election of officers resulted as follows:

President, H. F. Partridge, of the T. M. Partridge Lumber Company, Minneapolis.

Vice-president, J. C. Kirkpatrick, of the National Pole Company, Escanaba, Mich.

Treasurer, W. B. Thomas, of the White Marble Lime Company, Manistique, Mich.

Secretary, N. E. Voucher, of Minneapolis.

Directors, F. W. Wilhelmi, of the Cloquet Tie Post Company, Cloquet, Mich., and J. E. Gerrich, of the MacGillis & Gibbs Company, Milwaukee.

Among those in attendance were representatives of the following firms: Bell Lumber Company, Minneapolis; Brooks & Ross Lumber Company, Schofield, Wis.; Clark Pole & Tie Company, Bemidji, Minn.; Cloquet Tie & Post Company, Cloquet, Minn.; Crawford Cedar Company, Menominee, Mich.; Curry & Whyte, Duluth; Duluth Log Company, Duluth; Erickson & Bissell, Escanaba, Mich.; Larson Brothers Lumber Company, Minneapolis; Learned Cedar Company, Escanaba, Mich.; McCulloch & Moss, Minneapolis; MacGillis & Gibbs Company, Milwaukee; Martin Brothers, Duluth; Meloney Brothers, Spooner, Minn.; National Pole Company, Escanaba, Mich.; Naugle Pole & Tie Company, Chicago; Page & Hill Company, Minnepaolis; T. M. Partridge Lumber Company, Minneapolis; Pendleton & Gilkey, Minneapolis; St. Croix Pine & Cedar Company, Kelliher, Minn; C. P. Tinkham, Milwaukee, Wis.; Valentine-Clark Company, Minneapolis; Virginia & Rainy Lake Lumber Company, Virginia, Minn.; Western Electric Company, New York; Wisconsin Land & Lumber Company, Hermansville, Mich.

Edison Banqueted by Ohio Society of New York.

Thomas Alva Edison, illustrious son of Ohio, was the guest of honor at the thirtieth annual banquet of the Ohio Society of New York, at the Waldorf-Astoria Hotel, Saturday, January 15.

"Preparedness for Defense" was the subject of stirring addresses by the Hon. Henry D. Estabrook, the Reverend S. Parkes Cadman, D. D., and the Hon. Josephus Daniels, Secretary of the Navy.

Charles P. Bruch, president of the Ohio Society of New York, was a most entertaining toastmaster and chairman of proceedings. Over 800 sons of Ohio and guests attended the banquet, and the galleries were filled with visiting ladies, Mrs. Edison and party occupying the central boxes. Many men prominent in the electrical industry were present. During the evening the following message was presented to Mr. Edison from old associates in attendance:

"Thomas Alva Edison—Your early associates and members of the Ohio Society send 73 to the wizard of Menlo Park: Millard F. Anderson, David Homer Bates, David Homer Bates, Jr., Charles P. Bruch, Edward B. Bruch, Frank N. Dowler, Charles M. Higgins, Lincoln R. Hypes, Nathan C. Kingsbury, Harry B. Logan, Virgil W. Miller, Charles W. Price, George F. Randolph, John F. Schindler, George W. Spaid, Theodore N. Vail, Ralph H. Wallace."

The great inventor was in perfect health, and through Mr. Bruch made an enthusiastic response to the felicitation accorded him.

There are over 500 electric central stations in Japan, having a total capacity of about 728,000 kilowatts.

Mammoth Spring Hydroelectric Plant

Low-Head Water-Power Plant Constructed by the Mammoth Spring Electric Light & Power Company Combines Efficiency with Esthetic Appearance

By E. C. Bellamy

Mammoth Spring, Ark., is one of the many natural wonders of the United States which American travelers whom the European war is keeping at home will learn to visit in increasing numbers. Grand Gulf, Spring River and Mammoth Spring form a picturesque group whose beauty has not been marred by the hydroelectric plant by which they have been harnessed to serve the rapidly growing territory surrounding.

The water which supplies this plant flows directly from Mammoth Spring, the largest spring in the world. Two shallow streams about one-fourth of a mile distant from each other, flowing in the same direction over an elevated plateau, suddenly drop into canyons 500 feet deep. These two canyons form a junction half a mile below, where they strike a mountain lying directly across their path. This mountain has been tunnelled by the erosive action of the water, forming a picturesque natural bridge almost equal in size to the well-known Natural Bridge of Virginia.

After passing through the mountain the united stream strikes another mountain and tunnels it for several hundred feet, then spreading out into an immense underground lake, the exact area of which has never been ascertained. This underground lake is presumably the reservoir which supplies Mammoth Spring with its 60,000 cubic feet of water a minute. It is a curious fact that the flow from the spring remains practically constant regardless of the volume of water in the two streams which are supposed to feed it.

Mammoth Spring covers 18 acres of ground, and has a depth of 90 feet. It is confined by a series of three dams, forming three distinct lakes.

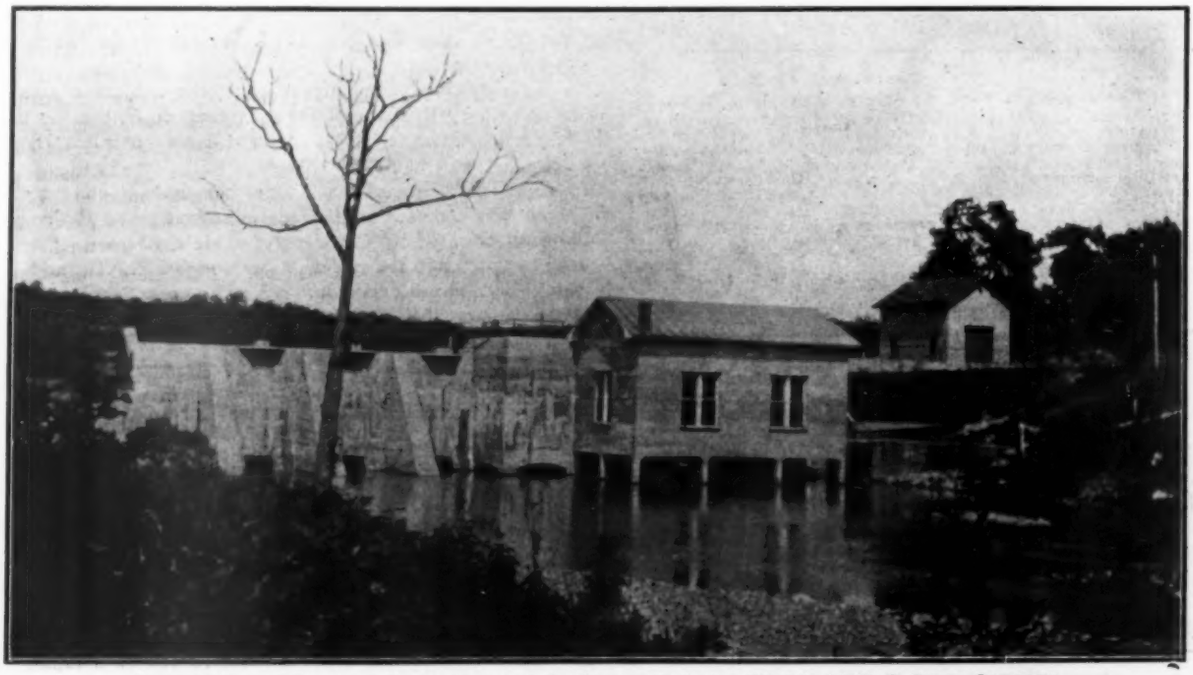
The first dam is of solid masonry, 170 feet long and 28 feet high. This fall affords mechanical power to drive the machinery in a large flour mill. The second dam, of approximately equal size, impounds water to drive two auxiliary generators which furnish current for distribution in Mammoth Spring, Ark.

The third dam is a reinforced-concrete structure, 24 feet high and 610 feet long. At this point is situated the generating station of the Mammoth Spring Electric Light & Power Company. It is a substantial concrete building, constructed as an integral part of the dam.

The power is generated by means of three Westinghouse 2,300-volt three-phase alternators, two of 375 kilovolt-amperes each; and the other at dam No. 2 of 150 kilovolt-amperes capacity. They are directly connected to two 35-inch Samson Lefell horizontal, center-discharge water-wheels, while the smaller alternator at Dam No. 2 is belted to a water-wheel of similar type and size. This arrangement will allow the smaller generator to be readily replaced by one of greater capacity as the maximum demand on the station increases.

Excitation for both alternators is furnished by an 18-kilowatt direct-current generator, which is belted to a Lefell water-wheel. The switchboard in the generating station consists of nine standard Westinghouse panels. These are of black marine-finished slate, and equipped with the usual arrangement of meters.

The Mammoth Spring Electric & Power Company serves a total population of about 10,000. Energy is transmitted at 33,000 volts over a 40-foot steel-tower transmission line 32 miles long, furnishing power to the towns of Thayer, Koshkonong, Brandsville, and West Plains. The connected motor load totals 192 horsepower, and the plant operates at a load-factor of 42 per cent. The possibilities of the territory served by the Mammoth Spring Electric Light & Power Company are shown by the fact that the increase in the business at the present time over that handled with the original plant is 700 per cent.



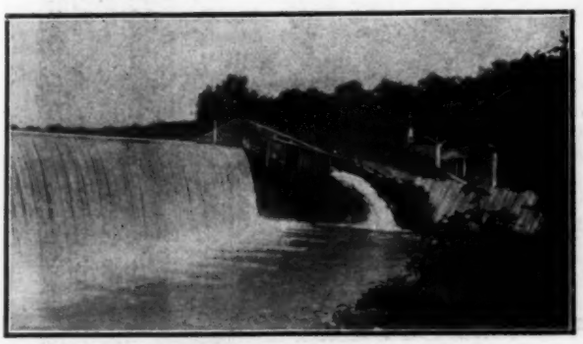
General View of Dam and Power House of the Mammoth Spring Electric Light & Power Company.

Steel Tower and Transformer Substation for Distribution to Mammoth Spring, Duplicates of Which Are Located at Koshkonong and Brandsville, Mo.

The transmission line consists of a three-phase line running from Mammoth Spring, Ark., to West Plains, Mo. The wires, which are of No. 4 bare hard-drawn copper wire, are carried on steel towers, 40 feet in height. Transformer substations are located at West Plains, Koshkonong and Brandsville to reduce the line pressure of 33,000 volts to a potential of 2,300 volts for local distribution. A view of one of these towers is shown herewith.

The transformers at the Mammoth Spring end of the line are located in a transformer house which is distinct from the generating plant. The equipment in this house consists of a bank of three transformers and a standard control panel. The transformers are each of 200 kilovolt-amperes capacity, 33,000/2,300 volts and are connected delta-delta.

In one of the accompanying illustrations is shown the transformer house, with its equipment of electrolytic lightning arresters installed out-of-doors, while another view shows the dam and spillway.



Another View of Dam, Showing Spillway.

Missouri Contractors Elect Officers.

The fifteenth semi-annual meeting of the Missouri Electrical Contractors' Association was held Saturday, January 15, 1916, at the Kupper Hotel, Kansas City, Mo. E. S. Cowie, president, presided at the meeting. The first action was the amendment of the by-laws, changing the date of the annual meeting to the third Saturday in January, and that of the semi-annual session to the second Saturday in July, or the Saturday immediately preceding the date of the national convention. New officers of the association were elected as follows:

President, Fred B. Adam, of the Frank Adam Electric Company, St. Louis.

First vice-president, William Koeneman, of the Guarantee Electric Company, St. Louis.

Second vice-president, Robert Baker, of Baker Electric Construction Company, Kansas City.

Secretary, A. J. Burns, of Economy Construction Company, Kansas City.

Treasurer, Edward Heath, of Heath Electric Company, Kansas City.

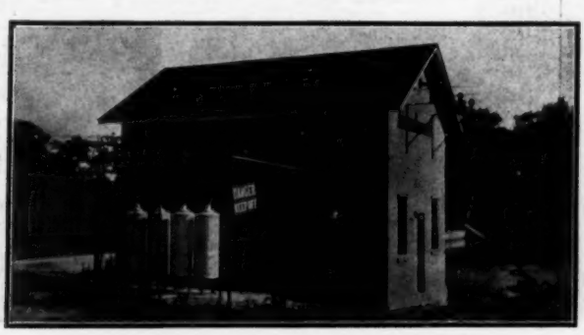
Sergeant-at-arms, L. E. Reed, of American Electric Company, St. Joseph, Mo.

A. P. Denton, who is president of the Denton Engineering & Construction Company, was elected national director. He said he would use every effort to put Missouri "on the map" in the National Association. The state association immediately took action that would enable Mr. Denton to do much active work in this respect, and he probably will use a great deal of his time in boosting national membership and in promoting its interests, as well as those of the state association. This action was a resolution that the $10 commission offered by the national for each new member, was to be turned into the treasury of the state association, and used by the national director in getting members.

The Legislative Committee was empowered and instructed to proceed vigorously in the effort to secure a state law for Missouri, which has already been introduced, providing for state examinations, licensing of contractors, and penalty for contracting by unauthorized persons. The committee consists of A. J. Burns, chairman; W. L. Hutchison, L. E. Reed and William Koeneman.

The Committee on Concentric Wiring asked more time for its investigations, reporting that it was gathering much useful information from contractors, and would have a report for the semi-annual meeting in St. Louis next July indicating the consensus of opinion of Missouri contractors. This Committee consists of W. L. Hutchison, Kansas City, chairman; L. E. Reed, St. Joseph; A. Penn Denton, Kansas City; Fred B. Adam, St. Louis; J. C. Bushong, Ottawa; J. A. Mercer, Topeka. The Kansas members were included last summer on the committee, that as broad an inquiry as possible from the district might be secured.

Following the business session, talks were made by guests, including J. A. Mercer and W. E. Barry of Topeka, and R. C. Stueve of Tulsa, Okla.



Transformer House at Mammoth Spring.

Electricity in the Manufacture of Gears

Electric Motor Drive is Being Successfully Employed in Two Large Gear-Manufacturing Plants Which Are Fully Described—Tabulated Motor Data are Given for Each Installation

Industrial Power Series—Article No. 151.

This article describes the electric motor equipment and the mechanical manufacturing processes of two large manufacturing plants in Syracuse, N. Y., using electric motor drive and central-station service exclusively. The companies are: Brown-Lipe-Chapin Company, manufacturer of automobile differential gears, and the Brown-Lipe Gear Company, manufacturer of various types and forms of automobile transmission gears and control sets. Before taking up the manufacturing details it may be well to consider some of the advantages of central-station service and motor drive in this class of industries.

In the manufacture of gears there is needed a large number of comparatively small machines and it is important that they be so located that the logical sequence of operations in the manufacturing process be carried out so that the material and finished products do not have to repass through any department. The nature of the machinery used naturally lends itself to group drive with a comparatively small number of machines driven from each motor. By this arrangement a single group or any number of groups of machines can be run during the noon hour or on holidays to accommodate a rush in any particular department. An accident to any group of machines interferes with that group only and if a single motor needs repairs, which seldom occurs, it can be quickly replaced by a spare unit. Friction losses are reduced to a minimum as there are only short line shafts and small belts. With central-station service, continuity of operation is secured as modern practice provides so many safeguards that interruption of the service is practically impossible. Another important feature is that motor drive affords uniform speeds which are important in the turning out of work of precision and it increases production and quality.

In case of an accident to an operative any group of machines can be quickly brought to a stop without interrupting or in any way affecting other groups. The maintenance expense of large belts and long lines of heavy shafting is eliminated. Furthermore, the electric motor can be overloaded to a considerable extent without serious variation in speed, while with a mechanical prime mover it is either "stalled" or slowed up and as soon as the load is reduced there is a surging caused by the effort of the driving engine to regain its equilibrium. This variation of speed is decidedly detrimental to the quality and quantity of the product.

Changes and Extensions Easily Made.

With electric drive and central-station service machines

Motor-Driven Screw Machines.

Gleason Gear Planers.

and motors are easily and quickly regrouped and additional machines and motors can be installed on short notice. Power is always instantly available and it is only necessary to throw in the starting device. Motors can be mounted on the wall or floor or suspended from the ceiling and can be located where room is not needed for manufacturing purposes.

Electric drive affords the only satisfactory propulsion where speed variations are essential for the performance of certain work. Auxiliary machinery, such as blowers, air compressors, pumps, etc., can be placed in pits, in outside buildings, or any convenient place without regard to line shafts or other driving methods. Where there are several buildings composing a plant, motor drive is especially adapted to the work. If mechanical drive is used for such conditions either a number of small and inefficient engines are required or cumbersome and power-wasting mechanical transmission has to be employed. The human element of a factory has to be considered as there is better feeling among the workmen where there are desirable working conditions and the surroundings are hygienic. Electric drive materially aids in maintaining these conditions. Electric drive can easily provide for increases in machinery and in the addition of new buildings as it is only necessary to run additional feeders and the central station provides an abundance of power during the entire 24 hours of each day. When a belt breaks only one group of machines is affected and with individual drive the belt in question is entirely eliminated. Fire risks are reduced and heavy belt connections from floor to floor are eliminated. Central-station service does much to relieve the smoke nuisance which is important where manufacturing plants are located in the central part of the city. Further there does not have to be made any elaborate provision for the shipment of coal and the disposition of ashes, only enough fuel for some low-pressure heating boilers is necessary.

Service for the companies described here is furnished by the Syracuse Lighting Company.

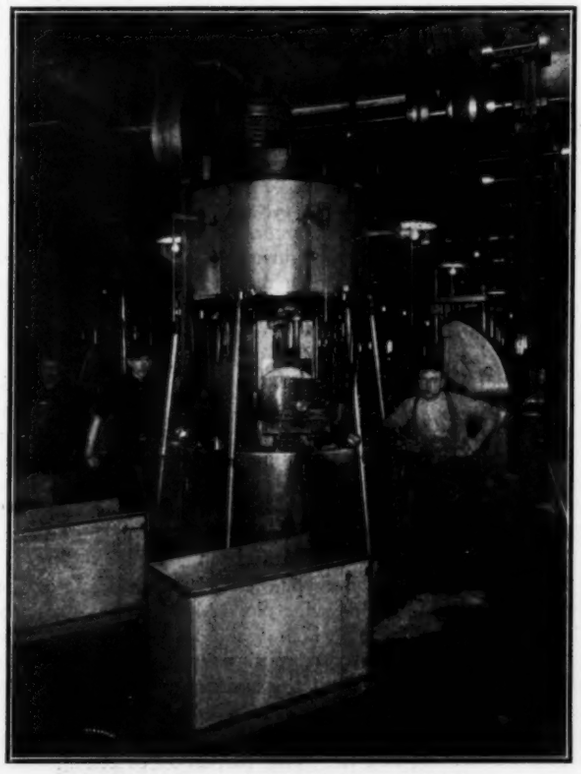
Installation of Brown-Lipe Gear Company.

The Brown-Lipe Gear Company originally came into existence in the early days of the bicycle industry as manufacturer of sprockets and two-speed gears for bicycles. From that start have grown two large manufacturing institutions that today supply a large percentage of the automobile manufacturers of the country with the differentials, transmission and control sets. In the plant of the Brown-Lipe-Chapin Company are produced the differentials, while the Brown-Lipe Gear Company confines its manufacturing facilities to the production of the various types and forms of transmissions and control sets.

In ordinary language, a differential is an assembly of gears that enables the rear wheels to move at different speeds. When an automobile turns a corner the inside wheel nearest the curb revolves slower than the outside wheel. The two rear wheels, which are the driving members, are locked together by the main axle shaft when the car is proceeding in a straight line and are both revolving at the same speed in proportion to the speed of the engine. Provision must be made, therefore, for breaking of this lock when the speed of the two wheels becomes different. It is this function of permitting one wheel to go slow and the other to go fast that is performed by the differential. The differential set consists of a pair of cases, a four-armed spider, two side gears, four side pinion gears, twelve cap screws, one bevel drive gear, twelve rivets, and one bevel drive pinion.

When a car is proceeding in a straight line the power is transmitted through the main driving shaft to the bevel pinion which is meshed with the bevel gear. As the shaft revolves the bevel pinion in turn revolves the main axle shaft and the entire differential assembly at right angles to the main driving shaft of the engine. The main axle shaft is in two parts, each one attached firmly to its road wheel and differential side gear. This simply makes the wheels revolve and propels the car forward.

When a turn is made, instead of the power revolving



Bullard Six-Spindle Automatic Gear Machine.

the entire differential as a unit, two side gears and four side pinions immediately begin to turn upon their bearings in the four-arm spider. In this way the difference in speed between the two wheels is assimilated or compensated for within the differential itself, by the pinions and side gears.

Before taking up the manufacturing process and the motor equipment it may be pertinent to give a brief general description of the buildings of the Brown-Lipe-Chapin Company. The main building is a modern reinforced concrete structure, of "L"-shape, five stories in height with a basement, making six working floors. There are 163,574 square feet of floor space including the hardening plant which is located in a separate building. The part of the building corresponding to the stem of the L is 297 by 71 feet, and the wing corresponding to the base of the L is 71 by 59 feet. The floors and the roof are supported by 34 reinforced-concrete columns. At the present time there are 800 day employees and 750 night employees.

The basement is occupied by the plumbing and blacksmith shops, the box department where the shipping cases are made, supply department, and the raw-stock department. The machinery and motor equipment in the basement consists of a size 12 by 12 by 16-inch Bury air compressor with a capacity of 620 cubic feet of air per minute belted to a 150-horsepower, squirrel-cage induction motor operating at 485 revolutions per minute under full load. There is a second air compressor of the same make with dimensions of 10 by 10 by 14 inches and having a capacity of 400 cubic feet of air per minute, driven by a 75-horsepower induction motor operating at 720 revolutions per minute. A 35-horsepower motor operating at 720 revolutions per minute group drives a Bradley hammer, two forge blowers, an exhaust fan, and two circular wood saws. Three cut-off saws and a drill press are driven in a group by a 15-horsepower induction motor operating at 710 revolutions per minute under full load. For the heating system there is an 8-foot Sturtevant fan driven through a Morse chain by a 50-horsepower variable-speed, slip-ring induction motor. On an upper floor there is a third air compressor, size 8 by 9 inches, with a capacity of 100 cubic feet of air per minute. The two compressors in the basement furnish compressed air for sand blasts, air lifts and the Gleason straightening and tempering machines in the hardening department, and the third compressor furnishes compressed air for pneumatic riveting machines.

Service is supplied by the Syracuse Lighting Company from the 2,300-volt, 3-phase, 25-cycle street mains. In the basement there is a transformer room where are located three 250-kilovolt-ampere, oil-insulated, water-cooled transformers with a transformation ratio of 2,300-440 volts. An additional bank of transformers with the same characteristics and rated at 150-kilovolt-amperes will soon be installed. The entrance switch is oil-break and located on a slate panel supported on an angle-iron frame. In addition there is a building feeder panel and a panel containing a graphic recording watt-hour meter. There are a total of 42 motors aggregating 1,400 horsepower and the average load carried is 800 kilowatts. The rate per kilowatt-hour, based on several factors, averages one cent. The monthly current consumption for seven months of 1915 is given on the motor data sheet.

Electrical construction throughout the building is of the most modern and approved style. All elevators are provided with a snap switch which, when on, locks the elevator control rope so that any tampering has no effect and the car cannot be started until the switch is turned off. The switch is inclosed in an iron box with a hinged cover and a hasp. All stairway lighting can be controlled from each floor landing and the lights turned on or extinguished from top to the bottom of the building from any one of the switches. A novel electrical attachment is used on the Gleason gear generators consisting of a small ruby incandescent lamp which automatically lights when the last tooth in the gear is finished.

Motor Applications.

The manufacturing process next demands attention. The gear blanks consisting of drop-forged rings of steel of approximately the shape of the finished bevel gear are received from a forge plant. The first operation is what is termed the rough forging inspection. The gear blanks are inspected carefully to see that there are no cracks nor flaws apparent from an outside examination after which a certain fixed percentage of these blanks is drilled sufficiently to get samples of the steel to be analyzed in the chemical laboratory. The entire shipment of rough forgings is held in the receiving stock room until the samples have been thoroughly analyzed. After the chemical analysis the gear blanks are still further prepared for the first machine operation by going through a preliminary heat-treating and annealing process. This makes the forging uniform in consistency throughout and removes the forging or internal strains.

In the machine department the first operation consists of boring out the center of the gear and facing the back so that it presents an absolute right angle to the bored center. This operation is then inspected with micrometers to insure absolute accuracy of size and is also tested on specially constructed jigs. The boring is done on a battery of boring mills including six machines which are group-driven by a 30-horsepower motor operating at 1,125 revolutions per minute at full load. This motor also drives a turret lathe and two small grinders. Located near the boring mills is an interesting group of machines consisting of seven broaching presses which make square holes in gears that move over a square shaft. The hole is made by drawing a series of dies through the round hole first drilled. This group of machines is driven by a 30-horsepower motor operating at 1,125 revolutions per minute under full load.

Motor-Driven Blower.

From the inspection, after the gear blank leaves the boring mill, it is sent to another machine which finishes the face and the back angle surfaces. This machine is individually driven by a 25-horsepower motor. The blank is then placed in what is called a running fixture and inspected while running, to insure trueness of the running gear. The blank is then placed in a jig, drilled and counterbored. This work is done on the drills indicated in the motor data sheet. At this point the various surfaces have been machined to such an extent that the blank itself can

Motor Data Sheet.

Brown-Lipe-Chapin Company, Syracuse, N. Y. Service from Syracuse Lighting Company—Three-phase, 25 cycles, 2,300-440 volts, 42 motors, 1,440 horsepower, 440 volts, squirrel-cage type unless otherwise noted.

Kilowatt-hour consumption, seven months:

Month.	Kilowatt-Hours.	Month.	Kilowatt-Hours.	Month.	Kilowatt-Hours.
June	287,800	August	282,100	October	360,000
July	294,900	September	319,200	November	306,000
				December (estimated)	308,000

Note—Letters fl following motor speed indicate full-load speed.

Average load for lighting and power, 800 kilowatts. Average cost of current per kilowatt-hour, one cent.

No.	Horse-power.	Speed, R. P. M.	Kind of Drive.	Application.
1	150	485 fl	Belt	Bury air compressor—size, 12 by 12 by 16 inches; capacity, 620 cubic feet of air per minute; use, sand blast, air lifts, Gleason straightening and tempering machines.
1	75	720	Belt	Bury air compressor—size, 10 by 10 by 14 inches; capacity, 400 cubic feet of air per minute; use, sand blast, air lifts, Gleason straightening and tempering machines.
1	35	720	Group	Bradley hammer, two forge blowers, exhaust fan, two circular saws.
1	15	710 fl	Group	Three cut-off metal saws, one drill press.
1	50	.....	Chain	Sturtevant 8-foot fan for heating system.
1	35	720	Belt	Air compressor—size, 8 by 9 inches; capacity, 100 cubic feet of air per minute; use, pneumatic riveting machines.
1	35	720	Morse chain	Root No. 4 blower—size, 14 by 38.5 inches; pressure, 2.5 pounds; capacity, 167 cubic feet of air per minute; use, air pressure for tempering furnaces.
1	25	720	Gears	Triplex pump—capacity, 250 gallons per minute; use, circulating cooling oil for tempering.
1	30	1,125 fl	Group	Seven broaching presses for making square holes in pinion centers.
1	30	1,125 fl	Group	Six small boring mills, one turret lathe, two small grinders.
2	35	1,500	Group	Thirty turret lathes.
1	35	1,500	Group	Fifteen turret lathes, two 4-way spider machines, group small miscellaneous machines.
1	25	1,500	Group	Ten Fay machines, group miscellaneous small machines.
1	35	1,500	Group	Three small engine lathes, 22 automatic screw machines, four multiple-spindle drills.
1	25	1,500	Direct	Bullard 6-spindle, automatic gear machine for facing gear blanks.
7	25	1,435 fl	Group	Ninety Jones & Lamson semi-automatic turret lathes for finishing parts of gears and cases.
1	35	1,500	Group	Fourteen engine-lathes, three shapers, five milling machines.
6	35	1,500	Group	Battery of 115 Gleason gear planers used in generating bevel gears.
2	35	1,500	Group	Battery of 39 Pilgrim machines for finishing pinions.
		1,440 fl	Group	Battery of 47 blocking machines for the rough cutting of gear teeth.
1	35	1,500	Group	Seven Jones & Lamson turret lathes, miscellaneous small drills, five engine lathes, two boring mills, one cutting-off machine.
1	25	1,435 fl	Group	Five Pratt & Whitney screw machines, four testing machines, seven Lucas presses, two key-seating machines, four engine lathes.
1	15	710 fl	Group	Two shapers, 12 drill presses, one slotter, one small shaper.
1	25	1,435 fl	Group	Nineteen drill presses.
1	50	720	Group	Twenty-nine grinders.
1	30	1,425 fl	Group	Sixteen grinders.
1	35	1,440 fl	Group	Nine test machines.
1	25	1,435 fl	Group	Miscellaneous small machine tools.

Brown-Lipe Gear Company. Service from Syracuse Lighting Company—Three-phase, 25 cycles, 2,300-400 volts. Seventeen motors, squirrel-cage type unless otherwise indicated in text.

No.	Horse-power.	Speed, R. P. M.	Kind of Drive.	Application.
1	25	1,200	Group	Four forge blowers, one Bradley hammer, one power hack saw, one emery grinder, four cut-off saws.
1	15	1,200	Group	Two circular wood saws, one emery grinder.
1	25	1,200	Group	One engine lathe, two special milling machines, one small drill, one emery grinder.
1	25	1,200	Group	Thirteen grinding machines, one small pump.
1	15	1,200	Group	One power hack saw, five engine lathes, three milling machines, two drills, one shaper.
1	25	1,200	Group	Two small drills, one shaper, one drill press, ten milling machines.
1	25	1,200	Group	One engine lathe, eight milling machines.
1	25	1,200	Group	Two small milling machines, one engine lathe, ten blocking machines, thirteen Fellow gear shapers.
1	25	1,200	Group	Ten Jones & Lamson turret lathes.
1	25	1,200	Group	Twenty-three Jones & Lamson turret lathes.
1	25	1,725 fl	Group	Three small special machines, twelve engine lathes.
1	15	1,200	Group	Three Pratt & Whitney grinders.
1	25	1,200	Group	Three engine lathes, two emery grinders, four traveling-bed milling machines, three special turret lathes, three drills.
1	25	1,200	Group	Three shapers, one engine lathe, four milling machines, six drill presses, one special lathe.
1	25	1,200	Group	Twenty ball-bearing machines.
1	25	1,200	Group	Three drills, emery grinder.
1	25	1,200	Group	One testing machine, six turret lathes, eight multiple-spindle drills, eight milling machines.

Gear Planers for Rough Cuts.

be held in a cutting machine which performs the next operation known as rough blocking or gashing of the teeth. For the rough cutting of the pinion and gear teeth there is a battery of 47 blocking machines driven by a 35-horsepower motor operating at 1,440 revolutions per minute full-load speed. The pinions are finished on a battery of 39 Pilgrim machines driven in two groups by two 35-horsepower motors whose rated speeds are 1,500 revolutions per minute.

The gears when removed from the blocking machines are again inspected and the blanks are sent to the gear generating department. It is here that perhaps the most unique operation in the entire manufacture of gears takes place. So remarkable is this process of generating a gear that no attempt will be made to go into details here. When the gear blank comes from this operation it is completely machined, and to all outward appearances ready for work. There is a battery of 115 Gleason gear-planing machines for this work which are arranged in groups and driven by seven motors, two of 25 and five of 35-horsepower capacity, with rated speeds of 1,500 revolutions per minute. The next process is hardening or heat tempering which takes place in the hardening department. The surface of the gear and the teeth must be hard to resist the wear during the operation of the car. The gears are subjected to a process which hardens the surface of the gear to a depth of one-thirty-second of an inch and refines the toughness of the core.

The hardened gear is then sent to the testing department in the heat-treating room, and by a variety of unique tests, is examined as to the hardness and evenness of hardening. The gear then goes to another machine for straightening it, inasmuch as it frequently bulges out of true during the subjection to extreme heat. An electric pyrometer is connected to each furnace and an accurate record of the time and temperature is taken. In the hardening department there is a Root No. 4 blower, size 14 by 28.5 inches which furnishes air at 2.5 pounds pressure to the tempering furnaces. For circulating the cooling oil, there is a 250-gallon triplex pump geared to a 25-horsepower motor operating at 720 revolutions per minute.

So far the machines and motors used for the principal manufacturing processes only have been enumerated. There are numerous groups of miscellaneous machines for the production of the various parts as indicated on the motor-data sheets. There are in addition several important groups of machines for special work, one of which is a battery of 90 Jones & Lamson semi-automatic turret lathes which are driven in groups by seven 25-horsepower induction motors.

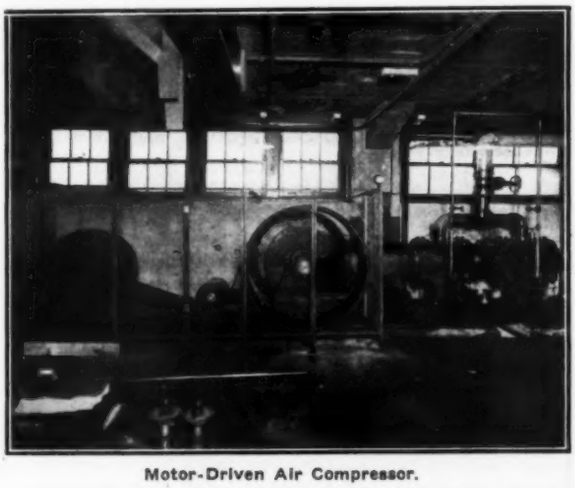
Brown-Lipe Installation.

Attention is next directed to the plant of the Brown-Lipe Gear Company, which, as before stated, specializes in automobile transmission gears and control sets. A transmission set is a combination of gears and shafts that provides for variable speeds and variable power applications to the driving wheels of the car. The necessity for the use of a transmission set is based on the principle that in internal-combustion engines the power delivered by the engine is absolutely correlated to the speed at which the engine is revolving. If a certain gas engine is delivering a certain power impulse, of say three horsepower at 200 revolutions per minute, at ten times that speed or 2,000 revolutions per minute, the engine will provide approximately ten times the power, or 30 horsepower. In the driving of every car there are times when great power is required at slow speed, as evidenced in the starting or driving through mud or hill climbing. It is obvious that it requires more power to move a car from a dead stop into motion than to propel a car forward on a perfectly level road. To accommodate the various operating conditions the transmission is built so that while the engine may be turning over at top speed and delivering its maximum power, the car may be geared down so that it is not moving at maximum speed.

In the production of the transmission gears, there is one feature which is carefully watched that is perhaps at a little variance with common practice. In the generating of gears, several blanks are laid one on the other, and put into a gear shaper in such a manner that the cutting tool works up and down over three, four or more gears at the same time. This work is done by 10 blocking machines driven by a 25-horsepower motor operating at 1,200 revolutions per minute, and 13 Fellows gear shapers driven by the same motor.

In order to have all of the teeth cut at absolute right angles to the face of the gear, the gear blanks must be absolutely parallel and accurate. All gear blanks are ground parallel before shaping by 13 grinding machines driven by a 25-horsepower motor operating at 1,200 revolutions.

As indicated in some of the preceding paragraphs, there is probably no single operation so important as that of heat treating of the metal after it has been machined. When the gears are brought into the heat-treating department of the Brown-Lipe plant they are first turned over to an operator who lays them out to be placed in a certain furnace. Each individual gear is then numbered in such a manner that two or three years afterwards, if the case requires, the gear can be identified as having been heated on a certain day, in a certain furnace, in a particular pot and position in the furnace.



Motor-Driven Air Compressor.

COMMERCIAL PRACTICE

New Business Methods, Policies, Rates and Kindred Central-Station Matters for the Man Engaged in Selling Electricity

Demonstrations of Electrical Appliances Made for Benefit of Housewives and Maids.

In an effort to emphasize the value of electricity to the housewife and to acquaint the women of Greater New York with the unlimited possibilities of electric cooking and heating appliances, the Bureau of Home Economics of the New York Edison Company has arranged a series of demonstrations and lectures to take place in the Forty-second Street Building. These occur daily between the hours of three and four o'clock, except Saturdays.

A general invitation has been sent out to the women of New York to visit the Edison Company's building during these demonstrations. And as an indication of the general interest in electric cooking and heating appliances, a score of women have accepted these invitations and large audiences gather at the Edison building daily.

Demonstration of Electric Cooking Appliances in the Forty-second Street Building of the New York Edison Company.

The demonstrations so far have been carried on by the employees of the Home Economic Bureau. Their method is to devote each day to a separate cooking appliance. Several grills are operated at the same time and the lecturer demonstrates what can be done with them and how they should be used to secure the most satisfactory results.

An interesting feature of this new work undertaken by the Edison Company is a class for servants which will soon be inaugurated. Maids will be taught the use of the various forms of household appliances and given a thorough training in cooking with electric utensils. This has been instituted in an effort to overcome one of the chief difficulties encountered by electric appliance salesmen who contend that the ignorance of domestics regarding electric cooking appliances is responsible for the loss of a number of possible sales.

A "Wireless" Sign Attracts Attention in Springfield Window.

A novel electric sign operated by a Tesla coil recently was shown in operation in a window display of the Springfield Gas & Electric Company, at Springfield, Ill. The sign is the invention of William R. Davis, chief electrician of the company, and has several attractive features.

The sign read "Do It Electrically" and in addition to the letters being formed by a series of blue crashing sparks, each letter was automatically spelled out in dots and dashes of the wireless telegraph code. The noise made by the sparks attracted attention and the curiosity of the spectator was aroused to interpret the meaning of the dots and dashes. A copy of the code as used was displayed on a large card near the sign so those not familiar with the meaning of the dots and dashes could watch and listen and identify each letter as it was spelled out.

The sign was made of billposter's tacks driven into a pine board stained black, a gap of about one-sixty-fourth of an inch between tacks being allowed. The board was mounted on a table and surrounded by a funnel of black cloth in order to exclude any outside light. The over-all dimensions of the sign were 4 feet long by 1 foot high. The letters were 4 inches high and 3 inches wide, making a total of 320 gaps which was equal to about a five-inch gap. The tacks being almost invisible in the dark background added some mystery to the sign and the quick-acting blue sparks gave a very sharp appearance to the letters. It could be seen and heard for about a block away. The 16 letters were spelled out in 45 seconds and at the end of this period the window lights were automatically turned on, displaying other electrical appliances in the window.

The dots and dashes corresponding to the letters of the signs were made by means of contacts of dot and dash size soldered on a copper ribbon which was then mounted on the rim of a wooden wheel about 10 inches in diameter. On one side of this wheel was a continuous copper strip which supplied current to the contact for flashing on the window lights during the time the sign was inoperative. Brushes of spring copper were used to convey the current to and from the wheel. To produce the sparks the high-frequency current of the Tesla coil was used. This coil was designed to give a spark of about six inches. The primary of this coil was made of copper ribbon one-half inch wide and one-thirty-second of an inch thick and consisted of 450 turns of No. 28 enameled-copper wire wound on a paper tube five inches in diameter, spaced 32 turns per inch. The Telsa coil was operated through a 0.5-kilowatt closed-core transformer with a ratio of 110 to 1,500 volts. A condenser consisting of 20 glass plates 8 by 10 inches covered with tinfoil 6 by 8 inches submerged in transformer oil was connected across the secondary of this transformer and discharged across a needle-point spark gap of about three-sixteenths of an inch through the primary of the Tesla coil. The energy input to the transformer was 200 watts.

Co-Operative 14 Months Appliance Campaign

Complete Details of a Comprehensive Sales Effort Inaugurated by the Pacific Gas & Electric Company Which Is Participated in by All Local Dealers

What is undoubtedly the most comprehensive current-consuming device campaign that has ever been conducted on a co-operative basis is now in progress under the auspices of the Pacific Gas & Electric Company, of San Francisco, in the entire territory served by the company. The campaign began on November 29 and is to continue without interruption for 14 months, during which time every customer served directly by the company will be visited by seven salesmen representing seven different dealers.

The general features of the campaign, which is novel in many ways, are best outlined in a general letter which was sent to the seven dealers who are participating in the campaign and to all employees of the Pacific Gas & Electric Company who are affected by it. The following data are taken from this letter.

There are many angles to the question of whether or not a central-station company should engage in the sale of appliances. Examples of successful operation under both policies can be cited almost without number.

It is quite generally believed, however, that by deciding to refrain from the handling of appliances the central station forfeits its rights to take an active part in building up this class of business. That this view is entirely without foundation is evidenced by the comprehensive campaign inaugurated in northern California under the auspices of the Pacific Gas & Electric Company, which is described herewith.

The Pacific Gas & Electric Company divided its territory into seven districts and assigned one district to each of the seven distributors of electrical appliances who are co-operating in the campaign. Every district is to be worked for 60 days by each distributor. Thus the campaign will continue for 14 months, during which time every customer of the company will be approached by seven different salesmen.

The Pacific Gas & Electric Company pays each salesman, employed by the distributor, $12 per week salary and in addition allows a commission of 50 cents for every new appliance placed on its lines. It also has dedicated all newspaper space regularly contracted for in its entire territory to the campaign.

It will be interesting to follow the results of this campaign, which is perhaps the most extensive ever conducted on a co-operative basis.

Division of Territory.

To enable the various distributors to thoroughly cover the Company's territory, seven districts have been created for the purpose of this campaign and are designated as Nos. 1 to 7 inclusive.

The following is the division of territory and to whom assigned:

District No. 1, comprising Oakland, including Emeryville and Piedmont, was assigned to the Western Electric Company.

District No. 2, comprising the balance of Alameda County, was assigned to Dunham, Carrigan & Hayden.

District No. 3, comprising San Jose and Redwood districts, was assigned to the Electric Appliance Company.

District No. 4, comprising Marin, Petaluma, Santa Rosa, Contra Costa, San Joaquin, Stanislaus and Electra districts, was assigned to the Electric Railway & Manufacturers Supply Company.

District No. 5, comprising Napa, Solano, Yolo, Nevada, Placer and Drum districts, was assigned to the Telephone-Electric Equipment Company.

District No. 6, comprising Chico, Colusa, Colgate, DeSabla and Marysville districts, was assigned to the Pacific States Electric Company.

District No. 7, comprising Sacramento district, was assigned to the Holabird-Reynolds Company.

STATEMENT OF CONSUMERS.

Division No. 1	29,186
Division No. 2	15,515
Division No. 3	15,252
Division No. 4	12,327
Division No. 5	7,283
Division No. 6	5,103
Division No. 7	11,134

The original assignments were determined by drawing lots.

Each of the above distributors agreed to work the territory allotted to him for a period, not to exceed 60 days, at the end of which time he will move on to the next district in numerical order. For instance the distributor in District No. 1 will at the end of 60 days move to District 2, and the distributor in District No. 7 will move to District No. 1. The work will continue in this manner until each distributor has worked in all districts, which will require 14 months, the period of the campaign.

Advertising.

The Company offered to place at the disposal of the distributors the advertising space it has in newspapers and other publications in all districts. The distributors will prepare their own copy which must be approved by the publicity manager of the Company before publication.

Each district manager of the Pacific Gas & Electric Company gives publicity to the campaign by arranging for the display of appropriate banners, cards, and other advertising matter in the office, show window, and on the vehicles of the Company, as agreed upon by him and the representative of the distributor in his district.

The Company has also arranged to attach to consumers' monthly bills, stickers or posterettes when furnished by the distributor.

The various district managers render all possible assistance in the distribution of literature descriptive of the appliances being offered for sale by distributors. This literature is given out over the counter and inclosed with bills sent out by mail. One of the conditions of the campaign is that all literature to be distributed by the Company must bear the imprint:

"For Sale by the Pacific Gas & Electric Company, and ———— dealers." The names of the distributor's local dealers are given in the blank space.

Selling Organization.

The distributors agreed to employ salesmen, either male or female, not to exceed five in number, which number shall be determined by the manager and shall be increased only by agreement of the distributor and the representative of the Company. Salesmen must in every instance be acceptable to the Company.

Distributors, their representatives, or salesmen are not to be permitted to make any collections, these being made by the Company's regular collectors or by some other person designated by the district manager.

One rather unusual feature of the campaign is that all salesmen are introduced by card, which is furnished by the

Company, upon application of the distributor. The distributors make request for cards by letter, giving the names of the salesmen, quantity required, and stating to whom delivery should be made. Salesmen present these cards when calling on a customer.

The Company pays the expense of transporting salesmen from one district to another once only, and to points within the district in accordance with its established practice. No funds for entertainment or living expenses of salesmen are allowed. All expenses of the distributor's crew manager and demonstrator are borne by the distributor.

Distributors also pay the expense of transporting salesmen to the district where the distributor is to initiate his campaign.

Salesmen are paid a weekly salary of $12 by the district office of the Pacific Gas & Electric Company. In addition to weekly salary they receive a commission of 50 cents on each appliance sold, such commissions are also to be payable weekly by the Company. Commissions on office sales are divided equally among the total salesmen employed in the district.

Salesmen are required to turn in daily time cards to the crew manager, who approves same and delivers to the district manager or some person designated by him. Salesmen record their sales in order books which will be furnished by the Company. The crew manager furnishes daily reports on sales.

Space is allotted in all offices by district managers for the proper display and demonstration of the various devices being offered for sale. Each distributor is required to remove his display at the conclusion of his work in the district so that the space will be available for the next distributor.

Handling of Stock.

The distributor or his representative must request the Company's district manager to place requisitions for appliances from time to time, as may be deemed necessary for the prompt filling of orders. Such requisitions are placed by the district manager in accordance with established methods of the Company.

Upon conclusion of the distributor's operation in a district he consults with the Company's district manager as to disposition of any unused stock, and it will be in order for the district manager to arrange with the manager of the district to which the distributor is moving to place a requisition, through the regular channels, for such unsold stock, it being understood that no distributor is to leave behind him any unsold stock.

The Company will not provide any stock to be left with consumers on trial, nor will salesmen be permitted to leave any sample stock with consumers for trial purposes.

Local Dealers Participate.

Local dealers participating in the campaign are encouraged to make proper window displays and demonstrations. Such dealers will receive from the Company 50 cents per appliance sold when placed on the Company's lines. They, however, must make application to the district manager for a supply of forms which must be used in obtaining a receipt from the purchaser of each appliance. These receipts must be turned in to the district manager, preferably weekly, and upon receipt of same by him the record will be entered on the consumers' cards. The dealer must keep a proper record of all sales and at the close of each month submit a statement to the district manager showing the number of appliances sold. The dealer must also file a copy of this statement with his jobber. Upon receipt of the monthly report with such proof as may be required he will receive payment from the Company.

Installment Payment.

Dealers have the privilege of making sales on the installment plan. They must make application to the district manager, however, for approved installment forms which, when properly filled out and accepted by the Company together with first payment, the dealer will receive the full retail price of the article from the Company. For instance, an appliance selling at retail for $3.00 cash, by installments will sell for the cash price plus 10 per cent, or $3.30. The dealer will receive for this contract when sold to a consumer on the Company's lines the sum of $3.00 and in addition thereto his regular allowance of 50 cents for each appliance sold.

No installment contract made by a dealer becomes an obligation on the Company until accepted by it and in all cases the 10 per cent added to carry the installment is to be deducted in the payment to the dealer.

The crew manager of the distributor is required to confer with the Company's district manager on all questions arising in the district which may require decision as to course of procedure when such matters are not covered by written instructions.

S. V. Walton, commercial manager of the Pacific Gas & Electric Company, is in direct charge of the campaign.

Descriptions of Forms Used.

The following is a description of the various forms used in the campaign.

Appliance Installation Record.

The district manager has one of these cards filled out with the name and address of each electric consumer in the district, the work being done with the addressograph whenever possible. They will then be turned over to the crew manager who will apportion a certain number each day to the salesmen who are to fill in the list of appliances already used by the consumer, and on the reverse side, the list of appliances he sells to him.

These cards when filled out by the salesmen must be returned to the crew manager who will be responsible for the systematic filing and safe keeping while he is in the district, that they may form a permanent record for the crew managers succeeding him.

Appliance Order.

This form is made out by the salesmen who will fill in all information and obtain the signature of the purchaser to all the copies. The original copies must be turned in daily to the district office, the duplicate is given to the purchaser at the time of taking the order, and the triplicate remains in the book to form a permanent record.

Appliance Sales Agreement.

This form is made out in duplicate in the district office in accordance with information contained on the Appliance Order. It is signed by the purchaser at the time of delivery of the appliances by an employee of the Company who shall leave the duplicate copy with the purchaser and retain the original for office record.

Appliance Sales Agreement for Dealers.

This agreement is used by dealers selling appliances on installments to consumers on the Company's lines. When the credit of the purchaser is satisfactory to the Company and the assignment of the agreement is made to the Company in accordance with instructions the dealer will be credited with the cash price of the appliance.

Certificate of Purchase.

The Company will allow the 50 cents per appliance to dealers selling appliances to consumers on the Company's lines only when this form is made out by the dealer and signed by the consumer at the time of purchase. The original copies of these certificates are turned in weekly to the District Office.

Notice of Assignment.

This form is made out in duplicate when Appliance Sales Agreements are assigned by dealers to the Company. The original copy is sent to the purchaser, the duplicate remaining in the office for record.

Lamp Socket Appliance Campaign Daily Report.

These reports are made out in triplicate daily by the crew manager and forwarded as follows: original to the district manager, duplicate to the distributor, and triplicate to the head office representative of the Company.

Monthly Statement of Appliances Sold by Dealers.

This form is made out at the end of the month by each dealer in quadruplicate, covering all sales made during that month for which he claims a revenue from the Company. The dealer must forward within ten days after the close of the month the original, duplicate, and triplicate copies to the district manager of the Company.

SUCCESSFUL COMMERCIAL MANAGERS.

S. V. Walton.

Those who were fortunate enough to attend the annual convention of the National Electric Light Association, at San Francisco last June, were agreeably surprised to learn from committee reports of the remarkable commercial development which has characterized the central-station industry in the West. One of the leading figures in this commercial activity is Stanley V. Walton, manager of the commercial department of the Pacific Gas & Electric Company, San Francisco. Mr. Walton is now conducting an appliance campaign, described elsewhere in this issue, that is perhaps without parallel in the history of the central-station industry.

Mr. Walton was born on a ranch in Sutter County, California, about 50 miles north of the City of Sacramento and practically in the center of the Sacramento Valley. His youth was spent on a ranch. After graduating from the country school he attended the Oakland High School, in Oakland, Cal., and later took the electrical engineering course at the University of California, graduating in 1904 with the degree of Bachelor of Science.

In the summer of 1898, together with a number of other young fellows from Sutter County, Mr. Walton went up to the Big Bend country, in eastern Washington, to help introduce the combined harvester for harvesting grain crops in that section. At that time most of the combined harvesters on the market were pulled by horses and mules and the machinery operated by the tractive effort of the wheels, although there were then on the market a few harvesters pulled by large steam-driven traction engines. Since that time the operation of farm machinery has been revolutionized by the gasoline engine, and now, in some instances, electricity is utilized, particularly for the operation of stationary apparatus.

In the fall of 1904 Mr. Walton had a short experience in merchandising business with the J. K. Armsby Company, of San Francisco. On January 6, 1905, he entered the employ of the California Gas & Electric Corporation, the predecessor of the Pacific Gas & Electric Company. His work in the beginning was surveying for electric pole lines. In March, 1906, he was transferred to the Land Department of the company, and in May, 1907, was appointed manager of the commercial department, which position he has since held.

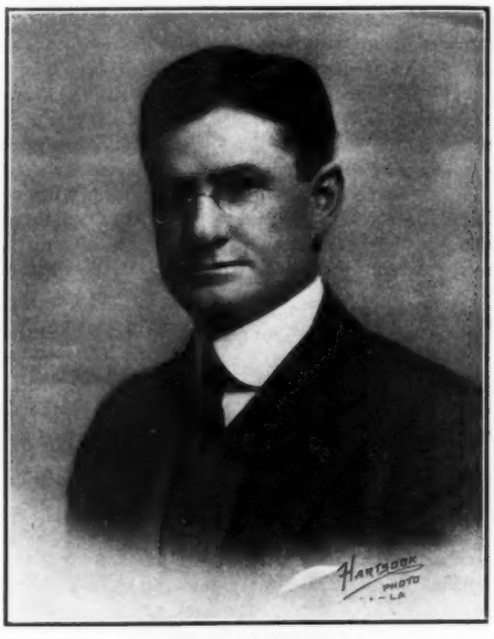
There have been a number of interesting developments in the company since Mr. Walton's connection with the commercial department. This company was one of the pioneers in the business of developing electricity on the farm, and considerable attention has been attracted by two booklets which Mr. Walton prepared, one in connection with electrically driven pumping plants and the other in connection with an electrical demonstration car. Both of these booklets were issued in the spring of 1912. The demonstration car was operated from April until September, 1912, both months inclusive, after which it was dismantled, as there seemed to be no further need for it. The car was exhibited at the state fair, early in September, 1912, and took first prizes for electrical devices suitable for household and farm use.

Mr. Walton learned early in his commercial experience the value of the small consumer; first, because of the fact that the small consumer pays a higher rate and when present in large quantities the cost of serving is not exorbitant, and second, if one or two of them drop out there is no great loss in revenue, as would be the case with larger consumers. Having once been impressed with this fact he has endeavored to develop the small consumers, particularly those on existing lines, although, of course, not overlooking the larger consumers as well, as it is the proper balance of large and small consumers that produces the large diversity-factor on a system such as that of the Pacific Gas & Electric Company.

In 1913 he conducted a campaign to replace gas engines with electric motors, and as a result secured over 100 new consumers aggregating a load considerably over 1,000 horsepower, practically all of these being located close to existing lines where the cost of connecting up was very small.

During the period he has been connected with the company there has been a very large increase in total revenue, due, of course, to increase in population as well as to the activities of the company in developing new business.

Mr. Walton has given a great deal of thought to the matter of co-operation with the various electrical interests —manufacturers, jobbers, dealers and contractors—and has in effect at the present time a co-operative sales campaign covering the entire system, in which all of the electrical interests are participating.



Stanley V. Walton,
Manager, Commercial Department, Pacific Gas & Electric Company, San Francisco.

He has taken an active interest in National Electric Light Association affairs for a number of years, and at the present time is a member of the Executive Committee of the Commercial Section. He was chairman of the Company Section of the N. E. L. A. last year and is now a member of the Executive Committee of the Section.

Increasing Business Makes Plant Extensions Necessary at Joplin.

The recent large industrial development of Joplin, Mo., and its district has been assisting, as well as reacting favorably upon, the Empire District Electric Company. The load on the plant has increased so rapidly that it now has left only about 30 per cent of reserve, and is not taking on any new accounts. Additional service is given only to customers already on the lines, and to these on condition that they relinquish service in case of trouble which requires use of the reserve. The press of business necessitated immediate enlargement of capacity, and the company has purchased an available turbine at Brooklyn, with a capacity of 9,000 kilowatts. The company is extending its turbine room at the Riverton plant to accommodate this machine.

POWER ENGINEERING

Problems Involving Motor Applications, Machine Characteristics, Power Sales Methods and Industrial Electric Heating

PLANNING A POWER SALES CAMPAIGN.

Details of Methods for Organizing a Power Bureau and Systematically Securing Industrial Business.

By Thomas R. Hay.

The development of our industrial life is necessarily dependent upon the manufacture of power and the ability to utilize it in such form that it can be substituted for the physical work of man and electricity is the most convenient form in which this energy can be generated, transmitted and distributed to the various desired points of application. It is not in itself a source of energy, but is obtained, either directly or indirectly, by transformation in either a chemical or mechanical form and in all practical cases is again transformed before being utilized. This last transformation can be accomplished by means of the electric motor.

Ten years or so ago central-station managers were devoting their energies almost exclusively to the expansion of the electric illuminating business, unmindful of the fact that the requirements of their customers necessitated 24-hour service for a revenue load condensed in an evening peak of 3 or 4 hours. Gradually, however, they began to realize the necessity for increasing the operating load-factor and the over-all efficiency of the generating station made necessary by the increasing cost of efficient and reliable service and the more exacting requirements of the user. Attention was naturally turned to the industrial field for a solution of this problem and in proportion as the value of a day load was appreciated in just such a proportion was the central-station management aggressive in soliciting this class of business and progressive in its standards of equipment and service until now a central station is rarely found that does not systematically cultivate this field. And the natural result has been that, in most cases, the domestic and municipal illumination is a by-product of the central-station's activity. This remarkable progress has been largely due, initially at least, to the hearty co-operation of the manufacturers of electrical equipment who, in endeavoring to expand the market for the sale of their products, perceived in the central station an agent that could be interested and developed in a quick and easy manner. At first, central-station managements were slow to realize the possibilities offered by this new field and were somewhat reluctant to co-operate to the extent of reducing rates to a point where they would be at all comparable with the existing industrial manufacturing costs for power. But gradually and, in some cases, in spite of themselves, the load has been increased with the result that it is now considered possible to sell power at a low cost and yet at a profit. The initial users of central-station service were small operations, as it was not considered possible to sell this service to the large users. Now, however, no installation is too big and every user of power, other than central-station power, should be and is a legitimate prospect.

Make Complete Survey.

In beginning a campaign for the sale of electric power a good plan is to make a complete survey of the fields to be covered. This will require a quick, but reasonably accurate, census of all power users and the preparation of a report showing for each user the class of business, type of power in use, condition of the existing plant and of the business, the total available load and other pertinent data, together with an estimate of the probable annual revenue to be derived and the cost of adapting the existing plant to central-station service. A statement regarding the attitude of the prospect and other notes that may be of value in determining the most active ones and those which will be most benefited by the use of central-station service should be included. If the field to be covered is sufficiently extensive individual salesmen may be assigned to cover related industries or each man may be assigned to a district. If some districts are more important than others the more capable and experienced men may be assigned to handle the larger and more important prospects with less experienced men to look after the smaller ones.

With the information obtained from the census it will be possible to determine the areas of probable growth and to lay out the transmission and distribution circuits accordingly. The management will also have a very definite knowledge as to how much unconnected load there is available, how much work has been assigned to each salesman and, therefore, how much business he ought to be able to turn in. This census will also be a convenient means of determining the most active prospects which can be concentrated on, the spare time being used to keep the less active ones in line and to continuously keep before them the general advisability and economy of central-station service.

By assigning individual power salesmen to certain related industries it will be possible for them to become familiar with the general requirements of the specific installations and also to gain an intimate and accurate knowledge of the particular industry. Later he may be assigned to another industry and so on until gradually a more or less intimate knowledge of the fundamental conditions and requirements of each industry may be acquired. By this method the individual salesmen will be able to gain a knowledge that will enable them to secure for their customers the maximum benefits at minimum cost and maximum satisfaction. Where power salesmen work entirely by territories it is not possible for them to gain this detailed experience and knowledge as they will usually be called on to handle propositions involving several different types of industry in the same day and will, therefore, not study any particular one in detail. As a result, they are less liable to render their several customers as good service as would be possible if they specialized on certain related industries. Perhaps a combination of the two methods of specialization and territorial assignment would bring the best results while at the same time insuring intensive work in the individual districts. As a means of co-ordinating the work of the power sales force weekly meetings are usually advisable.

Every Power User a Prospect.

That every power user is a central-station prospect is axiomatic. Neither the kind of power he uses, the cost of it nor the mental attitude toward the central station

S U M M A R Y

1. Connected Load. This includes only the equipment taking service from the Central Station transformers
2. Maximum 5-minute Demand in kilowatts. By measurement or estimate.
3. Consumption in kilowatt hours. By measurement or estimate.
4. Estimated Monthly Central Station Charge.
5. Cost per kilowatt hour.
6. Operating load factor.
7. Estimated investment necessary to properly adapt plant to Central Station service.
8. Monthly heating cost on an annual basis

NOTE: Power service will be furnished at _____ volts, _____ phase, _____ cycles, and lighting service will be furnished at _____ volts, _____ phase, _____ cycles.
Necessary transformers and meters for recording the amount used will be furnished by the Power Company.

Summary of Data Collected Is Tabulated in This Manner.

can establish a negative to this statement. The improbable customer of to-day is the probable one of to-morrow. Unforeseen conditions such as a break-down, a large order taxing the existing equipment beyond its capacity, etc., may arise, making imperative the use of a power supply that is adequate and reliable and that can be readily increased. The successful power salesman will know personally every user of power in his territory, including those already connected to central-station lines as well as those operating isolated plants. His methods and knowledge will be of such a prompt and capable nature that when any questions arise relative to the use of the service he is selling, the applicant will instinctively turn to him for a solution. No problem should be too small or too simple to receive careful attention and none are too large. New business will develop automatically and in unforeseen places if all power users, both connected and prospective, are served efficiently and continuously.

When the central station actively entered the industrial field for the purpose of selling electric power, many plants were easily convinced that it would be advantageous to use this type of service. Many plants were found to be ideal prospects due to having grown beyond the existing facilities; to antiquated and inefficient equipment; to necessary enlargements made necessary by increasing manufacturing requirements; to poor mechanical lay-out, etc., and it was not difficult to induce them to contract for central-station service. Gradually, however, the field covered by the individual organizations has become pretty well filled with plants using central-station service, but in many cases intermediate and large operations were still generating power locally.

In order to get these plants on the lines of the central station a continued and efficient effort is necessary. In the early days such effort was not put forth, due to the fact that so much easily procurable load only awaited intelligent solicitation, and that it was not, in most cases, believed that the ends justified the means, and that eventually these isolated plants would become central-station consumers without an appreciable amount of effort being expended. In some cases this attitude on the part of the central station was justified, as in the case of rebuilding or enlargement of the existing plant, rearrangement of the equipment to keep up with increasing and enlarging requirements, or because of a destructive fire, etc.

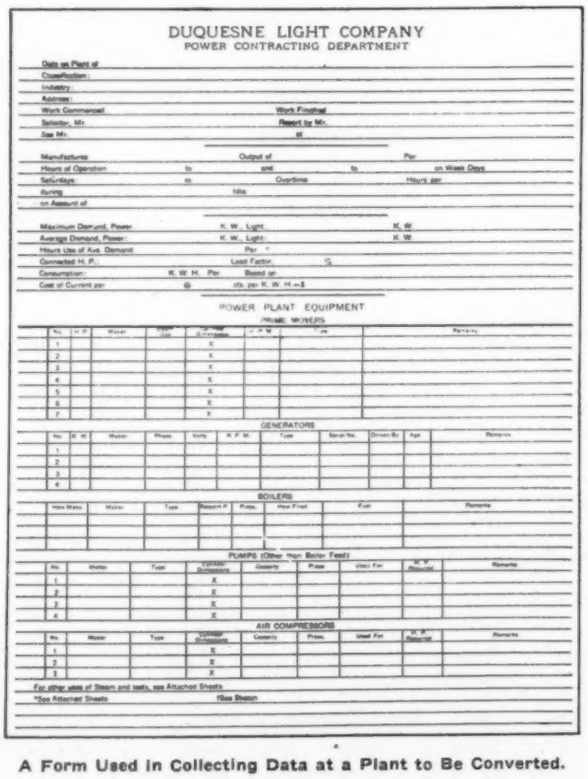
Thorough Analysis of Existing Conditions.

When such fortuitous conditions as those mentioned are not present and the manufacturer still holds out in opposition to purchased power, the only alternative is to sufficiently interest the prospect to obtain authority to make a thorough analysis of the existing power conditions and lay-out and from the information obtained to draw up and submit a proposition contemplating the substitution of central-station service. If such a report is satisfactory from the central station's point of view but still does not swing the prospect into line, the only alternative is to file the papers for ready reference and to pursue a policy of "watchful waiting." Eventually a break-down; a rising unit cost, due to obsolete and inefficient equipment; poor lay-out and uneconomic operating conditions; expansion, making additional equipment and power necessary; and the like will cause the manufacturer to stop and take thought and then with the report on the plant in hand, the power salesman will be in a position to strike quickly and effectively and with a complete knowledge, not only of the conditions to be met and overcome, but with an accurate solution of the problem presented.

It is of course neither necessary nor advisable to spend much time and money on relatively small prospects, but in the case of the larger ones such a course is not only advisable, but, in most cases, necessary to obtain such information as will make possible the drawing up of a satisfactory proposition. The report should be detailed and extensive in accordance with the size and importance of the proposition and should contain as complete and accurate information as possible, properly and logically set down and in such form as to be readily intelligible to the prospect. The prospect, it must be remembered, is, in most cases, not an engineer, does not understand lengthy and detailed technical reports and will not take the time to analyze one, however much to his advantage such a course of procedure may be.

Details of Proposition.

The first page of the report should contain a synopsis of the results obtained, giving existing costs, where advisable and when they are available, connected load and estimated future costs when using central-station service, estimated saving, if advisable, necessary investment required to make


DUQUESNE LIGHT COMPANY
POWER CONTRACTING DEPARTMENT

Data on Plant of
Classification:
Industry:
Address:
Work Commenced — Work Finished
Solicitor, Mr. — Report by Mr.
See Mr. — at

Manufactures — Output of — Per
Hours of Operation — to — and — to — on Week Days
Saturdays — to — Overtime — Hours per
during — Idle
on Account of

Maximum Demand, Power — K. W., Light — K. W.
Average Demand, Power: — K. W., Light: — K. W.
Hours Use of Ave. Demand — Per
Connected H. P.: — Load Factor — %
Consumption: — K. W. H. Per — Based on
Cost of Current per — @ — cts. per K. W. H.=$

POWER PLANT EQUIPMENT

PRIME MOVERS

No.	H. P.	Make	Speed R.P.M.	Type	Cylinders	H. P. Rating	Fuel	Remarks
1					X			
2					X			
3					X			
4					X			
5					X			
6					X			
7					X			

GENERATORS

No.	K. W.	Make	Phase	Volts	R. P. M.	Type	Serial No.	Driven By	Age	Remarks
1										
2										
3										
4										

BOILERS

How Many	Make	Type	Rated H. P.	Press.	How Fired	Fuel	Remarks

PUMPS (Other than Boiler Feed)

No.	Make	Type	Cylinder Dimensions	Capacity	Press.	Used For	H. P. Required	Remarks
1			X					
2			X					
3			X					
4			X					

AIR COMPRESSORS

No.	Make	Type	Cylinder Dimensions	Capacity	Press.	Used For	H. P. Required	Remarks
1			X					
2			X					
3			X					

For other uses of Steam and loads, see Attached Sheets
*See Attached Sheets — Idle Steam

A Form Used in Collecting Data at a Plant to Be Converted.

the change, cost per kilowatt-hour and other unit costs that may have a bearing on the proposition. This synopsis should be followed by a few general and concise statements regarding the advantages to be derived from the use of central-station service, an effort being made to eliminate, so far as possible, technical terms and phrases not in common use, and to make that part of the report that first meets the prospect's eye as simple, logical, convincing and self-explanatory as possible. The fact that the business of the central station is the manufacture and sale of electricity should be especially emphasized. Such simple, clear and concise statements so placed in a report will show the prospect at a glance just what can be accomplished by the change and will usually act as a challenge for refutation.

If at all interested the prospect will probably want to know how the results were obtained and there should follow a detailed report of the tests made, together with complete data and information, set forth clearly, but in detail, so that all the several steps of the solution shall be readily apparent. This detailed statement should be of particular value, when properly made up, if the report is to be submitted to a consulting engineer for consideration.

It is not to be expected that a business man with no particular engineering knowledge will wade through a highly technical report to find how he will be benefited by using central-station service; hence, the desirability, even necessity, of placing the results as outlined above and in such a way that all the findings may be readily noted and easily understood. When submitting figures for observation and comparison, gross and net results should be given, together with the net cost per kilowatt-hour and with an explanation as to the amount and computation of the kilowatt-hours consumed. In order to save time and expense the investigations should be reasonably detailed and accurate the first time, so as to be of use for some time to come. Such a procedure prevents the piling up of reports, some of little or no value through lack of sufficiently accurate information, on the same prospect and makes available for instant use a valuable collection of information that is thoroughly logical and understandable as well as being reasonably accurate and comprehensive. And after a prospect has been converted into a consumer further interest in his operation should not be dropped. The power salesman can be of great assistance to his customer when purchasing any necessary equipment. Occasional visits will serve to make clear any points of difference that may arise regarding the correct interpretation of the contract or in the method of billing, thus keeping a satisfied customer and a booster instead of a dissatisfied consumer and a knocker. This co-operation will be to the mutual advantage of the central station and the consumer and will reduce to a minimum the chances of losing customers that it has cost time, money and effort to connect.

There are still many fields of application awaiting development. This is due to some extent to the lack of simplification of equipment on the part of the manufacturers and also, and primarily perhaps, to the lack of a reduction of power rates by the central station to a point which should prove universally attractive and economical to the user, especially in installations such as paper mills, laundries, etc., where steam is necessary in varying quantities and where the majority of the equipment requires constant-speed operation and can thus be handled fairly satisfactorily with a drive other than the electric motor.

Loyalty of Sales Force Necessary.

It should be the endeavor of every central-station manager to build up an efficient and loyal sales organization with every member co-operating and all working for a common end. And always the watchword of such an organization should be service, service in the form of information and advice, to prospects and also to connected consumers. In all cases whether the field to be covered is assigned to the sales force by industries or by territories, propositions originating in the different industries or territories should be in charge of the salesman assigned to that particular field and he should have personal charge and direction of all negotiations, co-operating and consulting freely with all other departments and with the representatives of the electrical manufacturers for information and advice. Such a procedure insures continuity of action in the handling of the individual propositions and brings the prospect into intimate and stimulating touch with one representative of the central station instead of into casual and indifferent communication with a number of representatives. After a prospect has been signed by the sales department, other departments responsible for the institution of the service contracted for should co-operate loyally by promptly ordering, constructing and making ready for use facilities for this service guaranteed by the sales department. The individual salesmen should not have to make excuses to their customers for delays in making service connections.

When business is hard to get and slow in coming in, the sales department should go at it harder than ever before. Each salesman should go over his assigned field and pick out and concentrate on those plants that would be most desirable as customers. A depression affords an opportunity to investigate such prospects in detail and to obtain data and information for the gathering of which the time necessary might not have been available when business was good. By assuring power salesmen of the stability of their positions, through good times and bad, there is given an extra incentive to dig up business and to spend some time and study on the various prospects that are located.

Always the central-station salesman must realize that he is not only selling electricity, whether power or light, but also service. And always he should be a salesman first and an engineer afterwards. He reflects the central station to the public and in proportion as he is courteous, aggressive and truthful in all his statements and relations with his public in just such proportion will he favorably reflect his employer to this public while at the same time fulfilling his mission and justifying his employment.

Industrial Heating Contract Secured in Chicago.

The Commonwealth Edison Company has recently closed a contract with the Ford Motor Company for the supply of current to its assembling plant located in Chicago for heating enameling ovens. Four ovens requiring 650 kilowatts will be equipped at once and the installation will later be enlarged. Three-phase current will be supplied at 230 volts and General Electric Company heating units are to be used.

Another large contract closed by the Commonwealth Edison Company last week is for 1,000 horsepower to be applied in driving motors for refrigerating equipment by the Chicago Cold Storage Company.

Convenience of Electric Heating.

Electricity is readily adaptable to any heating system. A hot-water plant with the water heated electrically has been found to have some advantages over direct radiation placed in each room. It is perhaps a little more economical and convenient to operate. One drawback is that the cost of installing the hot-water radiators and circulating piping is usually more than twice the cost of wiring the house. If a building is already piped for steam or hot water an electric boiler can readily be substituted for the coal-fired boiler. On account of the saving in initial cost most homes and stores are wired and air heaters placed wherever desired. This system is flexible, and very satisfactory and economical results are obtained.

ELECTRICAL CONSTRUCTION

A Department Devoted to Problems Relating to the Installation, Operation and Maintenance of Electrical Equipment

ELECTRICAL CONSTRUCTION AT CRANE PLANT, CHICAGO.

Details of a Recently Completed Installation Which Embodies Many Interesting and Unusual Features

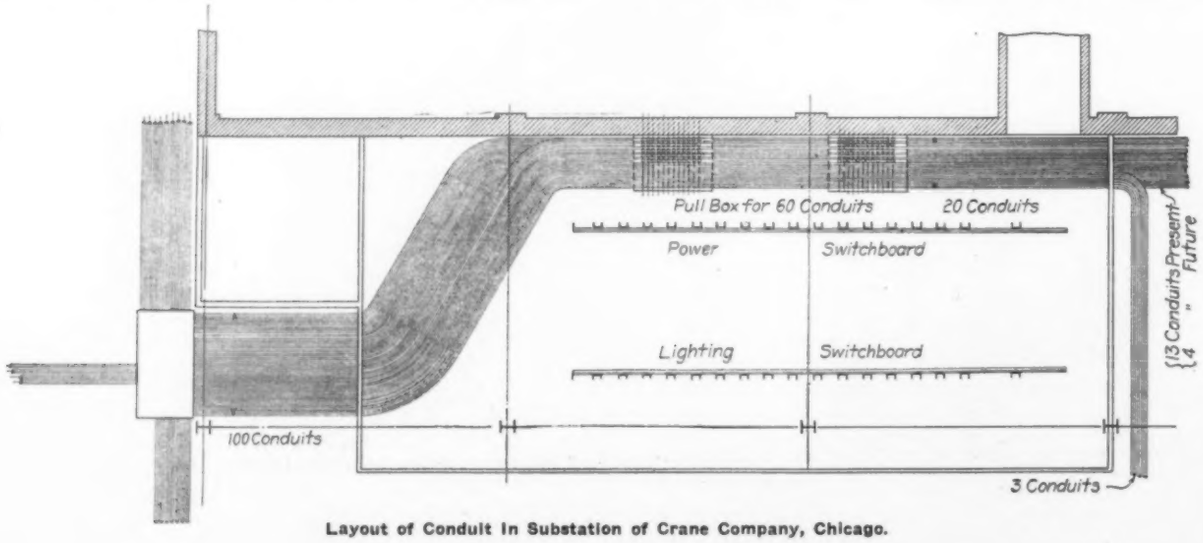
One of the most modern and comprehensive industrial institutions in Chicago is the new Corwith plant of the Crane Company, one of the world's largest manufacturers of valves and pipe fittings. A tract of land comprising 160 acres near the western boundary of the city was selected by the company as the site for its plant because of the transportation facilities and other features essential to a project of the magnitude of the Crane factory. At present about one-third of the acreage is utilized by buildings and yards, leaving a wide margin for future growth and extensions. About 15 factory buildings, office building, hospital and substation buildings comprise the group at present completed and occupied at Corwith, although as yet, many of the departments located at various isolated points about the city have not been moved to the new location.

All buildings are of modern reinforced-concrete construction with steel frames, and are laid out with a view to obtaining the greatest efficiency in handling material from the raw stage to the finished product. An underground service tunnel containing pipes for water and steam supply, gas, etc., connects all of the buildings. Transportation between departments and between various buildings is afforded by the means of electric industrial trucks of the company's own manufacture.

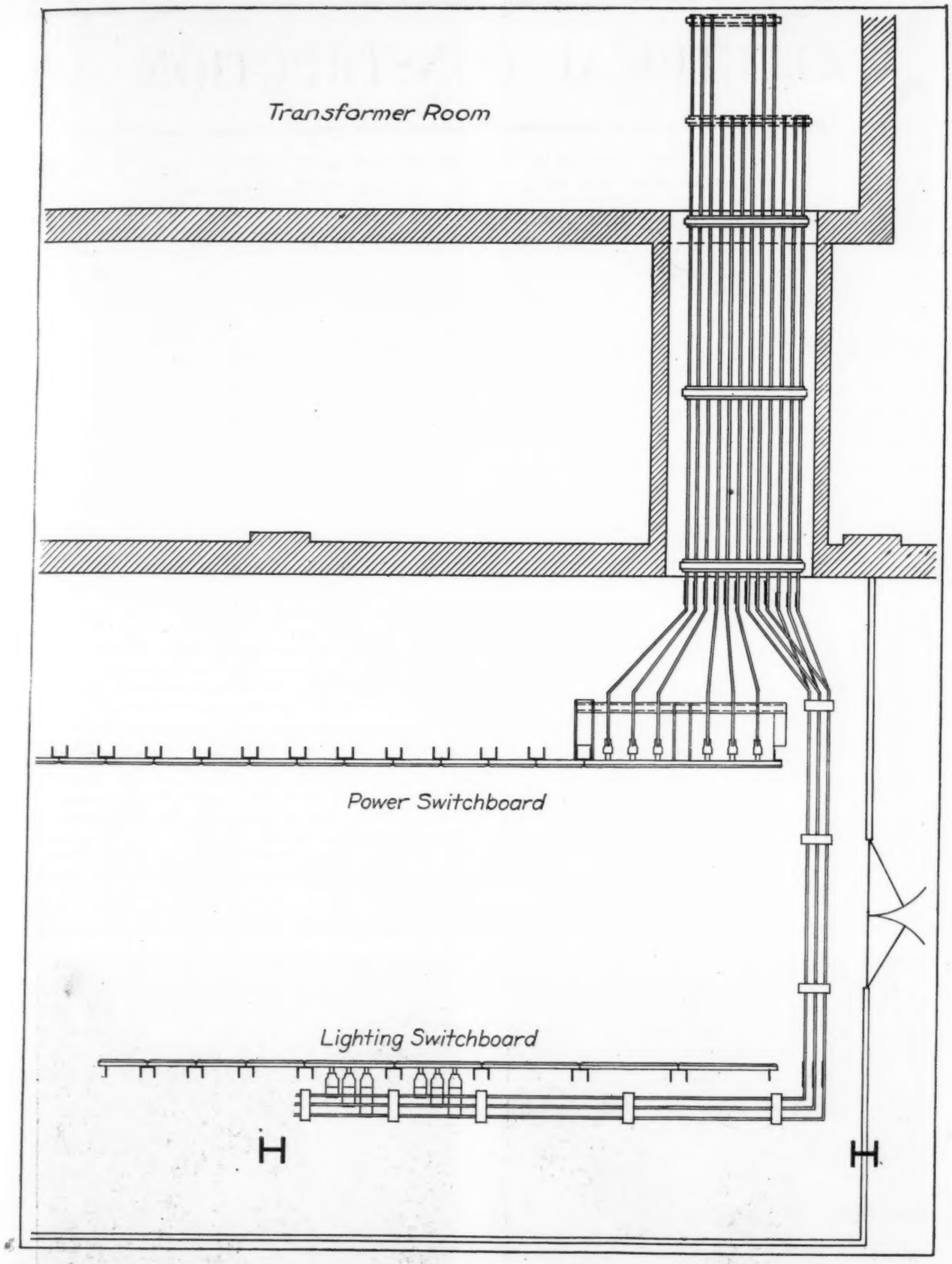
The above brief résumé of the general features of the Crane Company's establishment are given simply with a view to conveying an idea of the completeness and extensiveness of the plant. The electrical installation is in every way as complete and ranks among the foremost equipments of its kind in the country. While standard construction is adhered to throughout, nevertheless many ingenious features have been worked out under the direction of Harry S. Stewart, chief electrician for the Crane Company. For instance, under the conditions existing at the plant, Mr. Stewart believes that circuit-breakers are much more preferable than fuses for protecting circuits and consequently every motor in the plant and every lighting circuit is protected by a circuit-breaker, many of which were designed especially for this installation.

The total connected load at the Crane plant is approximately 2,000 kilowatts, of which about 500 kilowatts is for lighting. All energy for light and power is supplied by the Commonwealth Edison Company. Three direct power lines, two from the Quarry Street generating station of the Commonwealth Edison Company and one direct from the Troy Street substation supply the plant. There is a Crane substation for each group of buildings, each group comprising three buildings. Two central substations are distributing stations for high-tension energy which is distributed to two substations at the south end of the property and one at the north end. There are two lines connecting each of these substations, one being used in case of break down to the main line or for other emergency. The two main distributing substations, which are designated by the company as C2 and D2 respectively, are tied together with a tie line for emergency purposes. The high-tension supply is received at a pressure of 12,000 volts and stepped down to 240 volts, which is the working pressure in the plant.

One of the Commonwealth Edison Company's main lines from Quarry Street and the line from the Troy Street substation enter D2 substation. The other Quarry Street line which runs to the plant through a substation located at the Dickinson Seed Company's plant enters the C2 substation. At the south end of the property are two secondary substations termed E1 and E7. From the E1 station, energy at 236 volts is distributed through remote-control switches, controlled at the switchboard in the substation, to a group of adjacent buildings. The garage and main warehouse which is also at the southern end of the property receives secondary energy from the E7 substation.



Layout of Conduit in Substation of Crane Company, Chicago.



General Arrangement of Buses and Power and Lighting Switchboards in Typical Substation of the Crane Company, Chicago, Ill.

Main Power Board Showing Individual Circuit-Breakers for Each Motor Circuit.

Typical Lighting and Elevator Switchboard at Crane Company's Plant.

The high-tension feeders entering these two distributing stations are operated through disconnecting switches and remote-control switches, then through another disconnecting switch to the bus, which is separated by two sectionalizing switches where the lighting load is tapped. This arrangement permits the lighting load served by any substation to be supplied by either of the incoming lines.

All high-tension lines connecting the various substations are of varnished cambric and are run in underground conduit. Typical substation views are shown in the accompanying illustrations.

Description of Typical Substation.

The four substations which serve the plant from convenient centers of distribution are of the same general design and contain approximately the same equipment, differing only as to sizes and capacity, depending, of course, upon the present load served. In each, provision is made for extensions as the plant increases in size. In fact, the entire electrical system is so designed that additions and changes can readily be made to care for growth for many years to come.

A description of a typical substation will serve to indicate the completeness and high character of the installation at the Crane Company's plant and give a general idea of the methods employed in the remaining three stations. The substation designated by the company as C2 is best adapted for description as it is at present serving the largest group of shops and represents to a certain degree the ultimate development in the other stations.

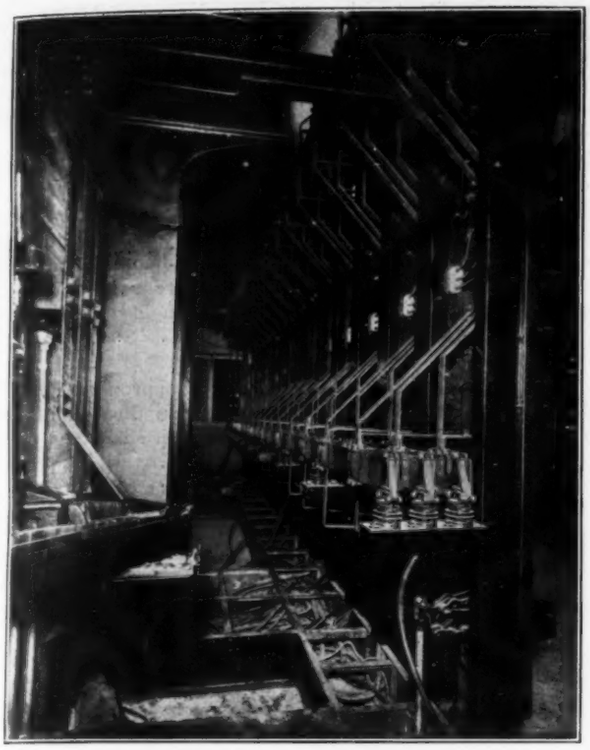
The substation proper really comprises two entirely separate buildings, one for housing the oil switches for control of the incoming high-tension lines and the transformer equipment for stepping down the voltage, and the other building contains the main power and lighting switchboards and a motor-generator set for supplying direct current for elevators, cranes, etc. Each building is of reinforced concrete construction measuring about 50 feet long by 25 feet wide. There are two 12,000-volt incoming lines which are run in underground ducts into the transformer room. These lines are protected by overload relays mounted on the main power switchboard and are controlled by oil switches also located in the switchboard room of C2 station, alongside of remote-control oil switches which control the main lines to the other substations about the plant.

There are eight 200-kilovolt-ampere Pittsburgh transformers in C2 station, six for transforming power voltage and two for the lighting supply. The power transformers are arranged in two banks of three each and reduce the voltage from 12,000 to 236, at which pressure energy is supplied to the motors.

The main buses from the transformers run through an overhead concrete duct which connects the transformer room with the switchboard room, the space between the two buildings being approximately 12 feet. The arrangement of the bus connections is shown in one of the accompanying diagrams. It will be observed from this view that the transformers are paralleled at the switchboard, which is provided with two buses operated from each bank

A Branch Box.

Main Box Outside of Substation.



Back of Power Switchboard.

of transformers, or if so desired the system can be operated open delta.

Because of the limited space back of the power switchboard, a rather unusual method had to be adopted for mounting the buses. Steel gusset plates are bolted to the angle-iron framework of the switchboard and the busbar supports are clamped to these in such manner that the distance between busbars has been reduced to a minimum. About 15 gusset plates are used, the supports being staggered on each. All busbar supports and insulators at the Crane plant were supplied by the General Devices & Fittings Company, Chicago.

There is a main circuit-breaker for each bank of power transformers located on the switchboard. The main power board is of black Munson slate about 12 feet high by 30 feet long and comprises at present 18 panels, including the two incoming-line panels. There are 16 panels for controlling feeders. On the former there are installed the usual curve-drawing voltmeters and other graphic instruments. The large circuit-breakers controlling main lines are of General Electric manufacture, known as type C.K. and are equipped with shunt-trip attachments, so arranged that if any one of the three overload coils operate, sufficient current will be transmitted to the other two to operate all three legs of the breaker.

One very interesting feature of the electrical installation at the Crane Company's plant is that fuses have been practically eliminated. All motor circuits are protected by individual circuit-breakers located on the main power switchboard. Because of the city inspection rules, which state that in case fuses are not used circuits may be protected with circuit-breakers providing that efficient supervision is maintained, circuit-breakers were provided in this instance having all three legs protected. Special circuit-breakers having three coils in place of the standard two are used. It is thus impossible to replace a breaker on overload or short-circuit until the trouble has been remedied. To further safeguard against accidents, a pilot light is provided for each breaker panel which is automatically lighted when a circuit-breaker goes out. This signal system further is arranged so that a telltale lamp is lighted in the office of the chief electrician and remains lighted until the breaker is returned. For the benefit of the station operator, a gong is caused to ring whenever a pilot light indicates a circuit-breaker out.

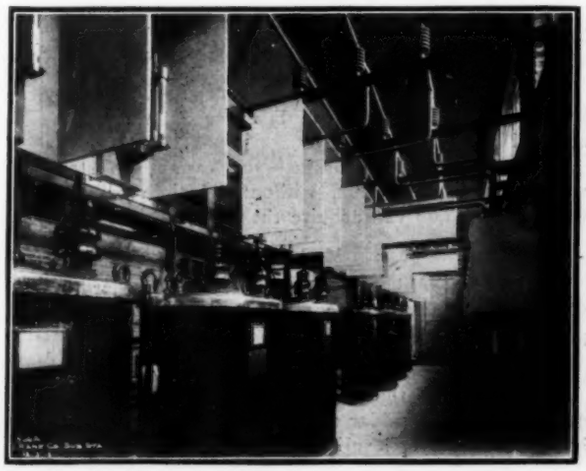
Power Wiring.

At present there are 112 power circuits controlled in this manner from the C2 substation, although the ultimate capacity will be 150 lines. The capacity of the station is 1,000 kilowatts, the power-factor 70 per cent at 236 volts and the load-factor, figured on a 24-hour basis, is 30 per cent.

The wiring from the circuit-breakers is carried in compartments, formed by the angle irons which support the switchboard, to a box on the ceiling back of the board where the conduits terminate.

As shown in diagram, the buses from the lighting transformers run through the same overhead duct as the power buses. Each transformer carries one-half of the lighting load. The lighting switchboard is located along the east wall of the station, opposite from the power board. It is also of black Munson slate, of ten panels, comprising two incoming line panels of 1,000 amperes each, one totalizing meter panel containing watt-hour meters and maximum-demand indicators, and feeder panels which contain a circuit-breaker for protecting distribution boxes for lighting service. The lighting load is approximately 250 kilowatts.

The elevator control board is located adjacent to the lighting switchboard and receives its energy from a motor-generator set, comprising a 225-horsepower motor with



Transformer Room in Typical Substation.

A Group of Motor-Driven Multiple Drills.

form-wound rotor, direct-connected to a 150-kilowatt, 250-volt direct-current generator, operating at 900 revolutions per minute. The leads from this generator are run in conduit under the floor of the station to the generator panel of the elevator switchboard where instruments are provided for measuring all energy delivered by this set. There are 16 elevator circuits, each provided with a double-pole circuit-breaker and knife switch.

All wiring from the power switchboard to motors is run in Galvaduct ranging in diameter from 1.5 inches up, depending upon the size of the conductor. Standard three-conductor, General Electric varnished-cambric cable of 1,200 volts capacity is used throughout. On wires of No. 6 size and smaller 30 per cent para rubber insulation is used. One view shows the arrangement of the conduit from the wire trough back of the power switchboard to the main distributing box located to the left of the switchboard room. This distributing box is shown in one of the accompanying views. All motors used throughout the plant are of General Electric manufacture. In the case of standard applications, that is on special direct-connected tool service, squirrel-cage motors are used in sizes up to 25 horsepower, above which size slip-ring motors are employed. Each of the squirrel-cage motors in sizes from 7.5-horsepower and above are equipped with oil-type starting compensators fitted with no-voltage release attachment and overload relays. On motors of five horsepower and under an ordinary oil switch is used, which is a modification of the standard compensator having overload relay switch working in oil, and no-voltage release attachment, and which is manipulated the same as the standard compensators. All compensators and switches are arranged for conduit wiring.

The conduit runs throughout the plant follow standard practice. The supports are formed by 0.75-inch bolts, secured to the ceiling by means of Diamond expansion shields. Conduit is run about one foot from the ceiling to permit of future extensions without changing the hanger.

Lighting.

The total connected lighting load is approximately 500 kilowatts. General lighting is adhered to throughout the entire plant, metal reflectors being used in shops and prismatic glass reflectors in offices. Type C Mazda lamps are used throughout, the 100-watt size in enameled-steel reflectors being used in the shops and 250-watt lamps in the offices. In the receiving buildings where there are higher ceilings 500-watt lamps are used.

An additional feature of the plant is a street-lighting system, employing 250-watt nitrogen-filled lamps.

Important Questions to the Electrical Contractor

By G. W. Hill

Eight pertinent questions of vital interest to the electrical contractor are suggested in this article. Each question will be discussed separately in subsequent articles by the author, who is well known in the electrical contracting field. The next installment, dealing with "Estimating," will be published in an early issue.

Estimating.

Do you know that if you spend your entire time and energy in the role of a Sherlock Holmes, gumshoeing around in an effort to learn what amount your competitor is going to ask for a certain job, rather than to ascertain your actual cost, that you may be led into a trap which will cause you to seek with less difficulty the bankruptcy courts for relief?

Salesmanship.

Do you know that the men who make the most miserable failures in business are those who permit their customers or competitors to set their prices?

Do you know that everybody is a salesman from the man who sells his labor by the day up to the President of the United States?

Do you realize without the use of salesmanship no man can succeed in any business?

Organization.

Can you go away and leave your business for a couple of weeks and return finding it in perfect condition?

If not you have not the proper organization.

Do you know that too much detail will make a clerk out of an executive?

Duty.

Do you know that it is going to be hard to explain to your family who may be in need, that you have wasted all of your productive years in an effort to put some one out of business instead of putting yourself in business?

Do you know that in doing business in a haphazard manner, and not making money, that you are imposing the same condition upon your competitor and lowering the standard of your business?

Do you know that in failure the money which you lose is oftentimes much in excess of your own?

Account Keeping.

Can you tell exactly where you stand in the commercial world at the end of each month, by reference to your financial statement? If not, you are at sea and should use care not to allow your creditors to find this out. They may refuse you further credit for this reason.

Do you know that your possibilities in business may be unjustly limited due solely to a lack of ability to produce a comprehensive financial statement?

If you are incapable of appreciating the difference between a gross profit and a net profit, and knowing the different ways in which an apparently handsome gross profit is whittled down to a miserable inadequate net profit or eventually to a minus quantity your aspirations should not raise above a weekly wage check.

Principle.

Do you know that the want of principle will cause you to be as much shunned in business as a leper is in society?

To be just requires brains—you cannot go straight without a determination, without principle or without will power. You can acquire these requisites.

Method.

Do you know that many failures are due largely to the lack of method, prudence, tact, knowledge and purpose?

Fourflushing.

Do you know that the fourflusher rises to the top quickly but the plodder remains on top to see him sink back to his proper level?

National Association of Electrical Inspectors.

HUBERT S. WYNKOOP, President, 1574 Fiftieth Street, Brooklyn, N. Y.
WASHINGTON DEVEREUX, Vice-President, 131 South Fourth Street, Philadelphia, Pa.
WILLIAM LINCOLN SMITH, Secretary and Treasurer, Concord, Mass.
R. P. STRONG, Representative on Electrical Committee of National Fire Protection Association, 809 Hibernian Bank Building, New Orleans, La.

Executive Committee
J. C. FORSYTH, Chairman, 123 William Street, New York City.

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"LET THE CODE DECIDE."

Secretary's Message.

The Secretary regrets that only one question appears this week; also for so little material lately. As a matter of fact, a Question Bulletin was sent November 21 to the Executive Committee, but to date of writing, December 26, so few replies (only 7 out of 25 members) have been received that the material cannot be used. If the members will not reply, what can the Secretary do? A, F and G, T, U, E, O, are all that have replied. F, G and A are section representatives; the others are not. The New Code being now out, perhaps some questions may come in soon. The Secretary has none except one question which unfortunately does not appear to fall under either of the two categories available for our columns. The various members simply must come forward and help.

December Meeting of the New York Section.

The fifteenth meeting of The New York Section was held Monday evening, December 13, 1915, in the Municipal Building, Manhattan, G. E. Bruen presiding. On the same date New York was completely in the grip of a snow storm which paralyzed street-car and railroad traffic. In spite of this, however, there was a fair attendance and no lack of enthusiasm. The members who braved the storm felt repaid, as Alfred E. Braddell's paper on the evolution of iron conduits proved to be the most interesting subject featured so far. Conduit developments, starting with E. T. Greenfield's asphaltum paper tubing, put on the market for the first time in 1889, "Brass-Armored Conduit" introduced in 1891, "Iron-Armored Conduit," lined with asphaltum-treated paper, brought out in 1894, and the present type of "unlined metal conduit" in use since 1897, were reviewed by the speaker and many of the old samples of apparatus and fittings were shown. Mr. Braddell next explained the methods used to prevent corrosion in conduit, taking up the enameling, electro-galvanizing, sherardizing and hot dipping processes.

Lastly he described the tests applied to determine the efficiency of such protective coatings.

There is no doubt every inspector will be interested in the processes described as well as the three principal tests known as the "potash test," "salt-spray test" and the "sulphate-of-copper or Preece test." Part I of the article referred to appears elsewhere in this department. Part II will appear in an early issue.

The matter appearing in this section consists of questions on the National Electrical Code, its interpretation and meaning, and questions as to whether certain methods of wiring are in accord therewith. These questions are gladly received from anyone interested, even if not a member; they should be sent to the secretary with any needed elucidating sketch. They are answered by each member of the Executive Committee according to his knowledge of what the ruling would be in his jurisdiction.

It should be understood that no pretense is made to give an authoritative interpretation of the Code. This is a voluntary association; it has representation on the Electrical Committee of the National Fire Protection Association, which prepares the Code, but it has no right, and claims no right, to give a final interpretation of anything in the Code. It is only intended to give the interpretation which seems correct to the members of the Executive Committee. No attempt is made to edit or correlate the answers from the different members of the Committee, as it is felt that the occasional difference of opinion is calculated to lead to a further study of the matter in question, further discussion and the final clearing up of obscure points.

The aim is to help toward a better understanding of the Code on the part of all; a more uniform conception of its meaning; increased precision in applying it; and harmonious action of those using it, for the common good.

Fusing Reverse-Current Relays.

Question 315.—In connecting up reverse-current relays, small lead wires, say No. 12, are connected to main motor leads No. 0 or larger. Rule 23b calls for fusing, but objection is made; companies not wishing the chance of blown fuses making relays inoperative, which in case of reversal of phases on elevator motor would cause serious accident. Should Rule be waived?

Answer 1(R)*. In such a case I think the inspector is justified in asking for appropriate fusing, as the current passing through such a device has a fixed maximum, depending on the impedance of same. A current of sufficient volume to melt the fuse would have to be caused by a short-circuit, which without fusing would simply cause a burnout of the relays or their feed wires, or possibly open the protection of the No. 0 wire.

Answer 2(O). The writer does not consider that Rule 23b would apply in this case. The relays should be considered a part of the motor-starting or controlling apparatus and can be very readily inclosed or guarded so that even if they should be destroyed no damage would result to surrounding materials.

Answer 3(S). There are many devices which should not become inoperative by failure of fuse or wires connecting same. This is of great importance in this question. Safety of life, in this city, is given first consideration and the fuse should be omitted in connecting relays of this type.

Answer 4(M). It has been our experience that relay circuits are never provided with fuse protection. The function of a relay ceases to a certain extent when fuses are installed in the control wires. However, for reverse-current relays, when used on high-potential circuits, fuses should be provided on the primary of the potential transformers. I do not consider fuses to be necessary on the secondary of the transformers as the high-tension fuses are usually of very small capacity and will open on any disturbance on the secondary circuit. For self-contained units, fuses should be provided on the potential circuit, but in no instance should fuses be installed in the current circuit.

Answer 5(F and G). In the placing of cutouts for a reduction in the size of wire it is often necessary when chang-

ing from large-sized cables to small wires to use a short section of small wire between the cable and cutout in order to make a satisfactory job. This, too, is a violation of the Code, but has been common practice for years and we think that the short section of wire necessary for the connection of reverse phase relays should have the same consideration given it, especially in view of the fact that a fuse connected to a device of this kind may be inoperative and not discovered until after an accident has happened.

Answer 6(W). Owing to the chances of introducing very serious life hazard, lead wires supplying current to the reverse relays in connection with alternating-current, elevator motors should not be fused, and the rule should, therefore, be waived.

Answer 7(P)*. I should waive the rule, in order to secure the greater, rather than the lesser safety.

Answer 8(E). We would waive the rule and ask that the relay be inclosed in a fire-resisting cabinet.

Answer 9(T). I do not believe that Rule 23, section *b*, should apply in connection with change in wire sizes to protective relays, owing to the short length of wire generally used, location and installation of such relays makes the increased fire hazard due to omitting the fuse of slight extent.

Answer 10(N)*. I do not consider there is any question of "waiving." As the phrase goes in law, "the question can be decided without considering that point," so we will omit any question of justifying such action.

I do not think Rule 23 has anything to do with the matter at all, but to general distribution circuits in buildings. This may also be inferred from the third paragraph on page 46, 1915 edition of National Electrical Code, definitely stating that a certain provision "shall also apply to motors." Notice also Rule 23*f*: "Each conductor of motor circuits except on main switchboard or when otherwise subject to competent supervision," etc. Again, Rule 2*c*, second paragraph: "For protection of instruments and pilot lamps on switchboards, etc." Protection of protective devices is not mentioned. The reverse-current relay should be guarded so its destruction will not endanger combustible material nearby, but it, like a surgeon on the firing line, must be ready at all times regardless of risk to itself.

Answer 11(U). I see no reason why the fuse should not be put in; as it can be fused high enough by using No. 12 wire, so that there would be no danger of the fuse blowing out unless something went wrong with the relays and then the fuse might as well blow as to have a short-circuit.

Electric Power Being Sent from Sweden to Denmark.

The Sydsvenska Kraftaktieselskab has begun to deliver electric power from Sweden to Denmark via submarine cable between Helsingborg and Elsinore, a distance of about 10 miles. To begin with only 500 horsepower is being transmitted. The power is produced by waterfalls in the southern part of Sweden. It is intended to increase the power to 5,000 horsepower in the near future.

Norwegian Hydroelectric Project.—A project has been started for utilizing the Saude Falls, in Norway, and the hydroelectric plant to be erected will have a capacity of 27,000 horsepower. Farther down the stream will be other plants generating 12,000, 45,000 and 12,000 horsepower, respectively.

CONDUIT EVOLUTION.[1]

Various Processes to Prevent Corrosion and Tests to Determine Efficiency of Protective Coatings.

By Alfred E. Braddell.

My subject being electrical conduits for buildings, I have thought, with your permission, it might prove of interest shortly to review the evolution of such conduits to date.

I feel that this subject should never be discussed without paying some little tribute to the originator and inventor of conduit as applied to building work, E. T. Greenfield.

You all undoubtedly know that prior to the entry of conduit into the electrical business, conductors in buildings were supported on porcelain insulators, etc., and one of the main difficulties encountered in a building of any dimensions was the lack of suitable mechanical protection for the conductors during the period of installation, they being injured by the fall of bricks, timber and other materials, and not receiving very much attention from the various mechanics on the job.

This condition of things was noted by Mr. Greenfield and he conceived the idea of running the various wires in a tube or conduit.

It was, therefore, in the year 1889 that Mr. Greenfield placed before the electrical world the first conduit ever manufactured, it being placed on the market by the Interior Electrical Conduit Company of New York.

This conduit consisted of paper treated with asphaltum and was furnished in the following sizes and lengths:

¼ inch conduit in six-foot lengths.

⅜, ½, ¾, 1, 1.25, 1.5, 2 and 2.5-inch in 10-foot lengths.

You will note that the majority of the sizes were in 10-foot lengths, which is the standard length of today; also standard diameters of the conduit.

It is interesting to know how the 10-foot length was arrived at. As Mr. Greenfield explained to the author, experiment showed that by taking various lengths of the product and holding it close to one end, and then snapping it like a whip he found that a length of 10 feet was sufficient to stand up under the strain without breaking. The one-quarter inch size would not stand the strain under this experiment in greater than 6-foot lengths.

These lengths were joined together by means of brass couplings, which were crimped tight to the conduit by a suitable hand device. Elbows for the various sizes of conduit were furnished and even in that early day Mr. Greenfield had designed a line of outlet boxes to be used in connection with the conduit system. This system of installing wires in buildings was naturally highly endorsed by engineers and architects, and, of course, duly accepted and approved by the fire underwriters.

At that date alternating current was not in vogue, therefore the rules called for a conduit for each wire, induction not having to be considered. While this type of conduit filled a long felt want, it was not a complete success principally because it had not sufficient strength to stand the abuse to which it was subjected by being walked on, run over by wheelbarrows, etc., but it was used without any material change from 1889 to 1891.

The next step to obtain a better and more substantial character of conduit was the placing of a brass covering over the same asphaltum-treated paper tube, such type of conduit being placed on the market in the year 1891 and manufactured by the Interior Conduit & Insulation Company and known as the brass-armored conduit. This was quite a step in advance over the original type from a mechanical standpoint, but it was still unsatisfactory, especially in buildings of a fireproof character, which more and more were being erected.

In order to meet the conditions encountered in such buildings, Mr. Greenfield then conceived the idea of using iron

1 Paper read at the New York Section meeting, National Association of Electrical Inspectors, December 13, 1915.

pipe and lining the interior with the asphaltum treated paper and such type of conduit was manufactured and placed on the market in the year 1894 by the Interior Conduit & Insulation Company, and known as "iron-armored conduit," this being the original iron conduit, and with same we finally obtained the two main requisites of a conduit system, viz., a continued raceway for the drawing in of wires and a complete mechanical protection for these wires.

I might state here that when this type of conduit was placed on the market the alternating-current system was coming into use and I recollect many instances where wires were run in separate pipes in accordance with the then existing Underwriters' Rules, thus causing induction trouble, and the rules, therefore, had to be changed to meet the altered conditions.

The iron-armored conduit held its own until 1897, in December of which year the underwriters approved the so-called "unlined metal conduit," this type being furnished with a black enamel finish on both the interior and exterior surfaces, and incidentally the rules called for a rubber wire having a double braid, instead of a single braid as was required for "lined conduit."

The unlined enamel-coated conduit being manufactured at a less cost than the lined type, also the cost of installation of the former being considerably less, as elbows could be bent on the job instead of purchasing formed elbows from the manufacturer of lined conduit, it will be naturally seen that the unlined conduit soon sounded the death knell of the lined type.

Mr. Greenfield, however, seemed determined to remain in the business which he created and in the year 1899, he produced another original conduit formed of steel strip known as flexible steel conduit, this being placed on the market by the Sprague Electric Company. This character of conduit is made in two types known as double-strip and single-strip types.

The former is constructed of two steel strips, one having a concave and the other a convex surface, spirally wound upon each other in such a manner as to interlock their concave surfaces. Each strip is thoroughly galvanized and a suitable gasket is provided between the inner and outer strips rendering the conduit moisture-proof.

The latter type is formed from a single steel strip in such a manner that it is interlocked and is also provided with a suitable gasket. The steel strip is galvanized similarly to that used for the double-strip type.

Both types are used extensively for new and finished buildings of ordinary construction and if desired to be laid in concrete the single-strip type is recommended, as owing to its formation it is of a more moisture-proof character than the double-strip type.

As the cost of installation is one of the greatest factors in the wiring of buildings, the thought undoubtedly occurred to Mr. Greenfield that a great saving of time could be gained if it were possible to pull in the raceway or conduit together with the conductors at one operation.

He certainly succeeded in doing this when he designed the flexible steel-armored conductors known to the electrical trade as "BX" cable, which was placed on the market by the Sprague Electric Company in the year 1899.

Here again was another original material and as you all no doubt know the idea was merely, so to speak, the forming of the flexible steel conduit over the conductors. This material I have no doubt is too well known by all to describe in more detail.

I may be permitted to quote at this point the following interesting phophecy made in 1889 by Fremont Wilson as published in the *Electrical Engineer* June 8, 1892.

Iron Pipes for Interior Conduits.

Two and a half years ago the writer was asked for an opinion in regard to interior conduits and to the surprise of the party asking the question, he said: "Interior conduits to be successful must be able to stand the action of all kinds of alkali in plasters, and must be absolutely proof against the tools of mechanics, and, furthermore, absolutely waterproof and fireproof, and must not be relied upon for *insulation, the only place for insulation being upon the conductors themselves.*" The question was then asked: "Why, then, do the New England Underwriters insist upon the use of conduits, and furthermore, allow the use of such cheap grades of wire?" The reply was, that any party or parties who recommended any conduit then on the market, or demanded its use, and allowed twin conductors with cotton insulation, was either ignorant of the entire subject, or was interested; for the only conduit that was needed was that used by the gas man, viz., iron pipe, to be made and installed under certain specifications. The writer also had the word of one of the largest pipe-makers that a first-class article of piping with right and left threads could be placed on the market at the same price as gas pipe, and perhaps cheaper; but the trouble with this system was simply that it could not be patented, and, therefore, underwriters, architects, and owners of buildings must be kept in blissful ignorance of the safety and feasibility of iron conduits so as to enable conduit people to line their pockets with the money of the poor public.

For this answer the writer was severely criticized by certain parties, but, nevertheless, time has proved that the remarks were correct, inasmuch as, at the convention held at Buffalo in February of this year, Captain Brophy, formerly of the Boston Insurance Exchange, was forced to admit that the conduits used were a failure.

The writer over two years installed in New York an installation of over 3,000 lamps, and all the primary feeders connecting the various converters were placed in gas pipes. The pipes were laid on iron ledges of the building and white-core taped wire used; and, although these pipes and wires of a total length of about two miles were placed in position by inexperienced men, yet they have been in constant successful use for eighteen months, conveying a current of 15 amperes and 1,000 volts, constantly exposed to the weather; and yet we hear that it can't be done—that to install iron pipes and pull in wires for use at 50 or 100 volts pressure would be suicidal.

Is not every combination gas fixture an example of conduits?

That the conduit people have seen their blunder is only too evident as we all know, from the fact of their covering their present material with metal; but let us hope that before long the underwriters will not only *allow*, but *insist* on, solid metal conduits specially built and installed in all classes of concealed work, and then, and not till then, will this everlasting hue and cry about electric-light fires cease.

The New Orleans underwriters have just adopted a stringent rule in regard to conduits, but they are simply recommending a special conduit, although it does not show on the face of their order, and they will go through the same experience, only in a less degree, that the Boston underwriters have passed through. There is, in the writer's judgment, but one conduit; and let us learn a lesson from our enemy, the gas man, and use it—the iron one. I may add that the Chicago underwriters have recently stated that they are in favor of iron conduits and the question must soon be faced by all concerned.

(To be continued.)

Record Production of Copper in 1915.

The production of copper in the United States in 1915 passed all previous records, according to the United States Geological Survey. At an average price of about 17.3 cents a pound, the output for 1915 has a value of $236,000,000, compared with $152,968,000 for the output of 1914.

According to the statistics and estimates received, the output of blister and Lake copper was 1,365,500,000 pounds in 1915, against 1,150,137,000 pounds in 1914.

The output of refined copper from primary sources, domestic and foreign, for 1915 is estimated at 1,647,000,000 pounds, compared with 1,533,781,000 pounds in 1914 and with the previous record production of 1,615,000,000 pounds in 1913.

The average price of copper for 1915 showed a marked increase over that of the preceding year, being about 17.3 cents a pound, compared with 13.3 cents in 1914.

Anthracite Production in 1915.—Estimates prepared by the Anthracite Bureau of Information at Wilkes-Barre indicate that the production of anthracite coal in Pennsylvania in 1915 shows a decrease, as compared with 1914, of about 2,000,000 long tons.

PUBLIC SERVICE COMMISSIONS

A Resume of Important Decisions of the Week Affecting Electric Utilities

ARIZONA.

Pacific Gas & Electric Company. The Commission has investigated the complaint of a real estate firm based upon the refusal of the Pacific Gas & Electric Company to refund $221 deposited to secure an electric extension to Bella Vista Place, a sub-division to the City of Phoenix, comprising 30 acres divided into 127 improved lots. It was found that six houses have already been constructed, plans have been drawn for six more and the construction of 12 more is contemplated. The power company already had a line passing the sub-division which was serving farmers and other consumers in the vicinity. The Commission found that the estimated yearly revenue from the tract was more than half of the cost of construction to the customers and the deposit was ordered refunded.

CALIFORNIA.

The Railroad Commission has issued an order authorizing the Pacific Gas & Electric Company to issue $2,500,00 par value of first preferred stock and $2,000,000 face value general and refunding bonds. The company is also authorized to use $2,573,046 cash on hand from the sale of preferred stock, together with $130,005, due on unpaid subscriptions for this stock, to reimburse its treasury for money spent upon its system from May 1, 1914, to August 30, 1915. The first preferred stock must net the company $90 a share, and the bonds 85 per cent face value, plus accrued interest. The funds received from the sale of the first preferred stock and of the bonds are to be used to reimburse the company's treasury for plant expenditures to August 31, 1915, in the sum of $491,744 and pay for extensions, additions and betterments in the sum of $3,150,000. This amount, the company estimates, will have to be spent, because of the development of its business, and the forseen addition of new consumers in 1916.

MAINE.

The Public Utilities Commission has approved the consolidation of the Penobscot Bay Electric Company and the Greenville Light & Power Company with the Central Maine Power Company by the purchase of the Greenville Company by the Penobscot Company and the purchase of the entire capital stock, $200,000 par value, of the Penobscot Company, by the Central Maine Power Compay. This consolidation will make the Central Maine the second largest public utility in the state, not considering the Maine Central Railroad.

Two primary questions were considered by the Commission: whether it was wise to permit the Central Maine Power Company to make this important addition to its already large field, and whether that company was getting value received for money paid or securities issued in the acquisition of the other properties.

The Central Maine had outstanding, prior to this consolidation, securities to the face value of $7,858,500. With the new properties it will cover or partially cover nine of the 16 counties of Maine in its operations.

The company is utilizing only about 50 per cent of the electrical power available in its several plants, besides vast undeveloped water powers yet to be developed as the demand for power increases.

The Commission decides from a careful analysis of facts and figures that the stockholders' rights will be protected by the new acquisition. From the public standpoint, the properties of a public service company, being devoted to a public use, stand on a somewhat different footing from others, it points out.

"A great trust is reposed in the officers of this particular company," the Commission says. "If we did not have the fullest confidence in our Utilities Law as a regulative force, a full belief that it is only by large development and widespread opportunity for use of our great water powers that low rates for light and power can be obtained for our farms and city consumers, a conviction that this petitioner intends (and under the Utilities Law can be compelled) to share fairly with the public, in the form of lower rates, the benefits resulting from the granting of this petition—if we did not feel reasonably convinced that nearly all doubts could be resolved in favor of the public, we would not follow the course we have decided upon."

The Central Maine Power Company is authorized to purchase the entire capital stock of the Penobscot Company—2,000 shares, of which 1,317 are issued and the balance in the treasury—and all outstanding mortgage bonds of the Penobscot Company and of the Belfast Gas & Electric Company, paying $618,000 for the purchase, of which $538,000 is to be in cash and $80,000 in 6 per cent preferred stock; the Central Maine is to issue 5 per cent mortgage bonds, due in 1939, to the amount of $433,000 par value, and 6 per cent cumulative preferred stock to the amount of $207,000, par value.

The Penobscot Bay Electric Company is authorized to issue securities in the form of promissory notes to the amount of $243,000, payable in two years, at 5 per cent interest, for the purchase of its subsidiary, the Greenville Light & Power Company.

MARYLAND.

Rules for Electric Service. The Commission has decided to adopt a set of rules governing electric service throughout the state, as it has done in the case of gas service. A conference was held with representatives of the electric companies on January 12, for the purpose of discussing the new rules prepared by the engineering department of the Commission.

NEW YORK—First District.

The annual report of the Public Service Commission for the First District was submitted to the Legislature during the week. It shows the heaviest year's work in the history of the Commission. The report states that 73 contract sections upon the city-owned lines of the dual system of rapid transit are either completed or under way, leaving only 16 sections yet to award. Rapid transit contracts awarded during the year 1915 aggregated more than $26,000,000. During the year the Commission held 812 hearings, considered 337 formal cases and held 118 meetings. The reports of accidents on railroads and street railroads for the year show a decrease in the total number of accidents and a decrease in the number of persons killed, from 292 in 1914, to 231 in 1915.

NEW YORK—Second District.

The Public Service Commission has received the opinion of Justice Howard of the Appellate Division in the appeal of the Niagara & Erie Power Company from a decision of the Commission. The decision of this case will be of importance to all town authorities and to all persons seeking franchises from them for the approval of the Commission.

The appellate division holds that the term "town authorities" contained in the law requiring franchises to be secured from them, refers to the town board, and not to the superintendent of highways. It will hence hereafter be necessary for franchises to be sought only from the town board.

For a great many years the Commission has held that the consent of the town superintendent of highways was necessary on a franchise which came before it for approval. It denied approval of a franchise of the Niagara & Erie Power Company in the town of Portland, Chautauqua county, because it was not granted by the town superintendent of highways, but only by the town board.

Justice Howard, in his opinion for the appellate division characterizes the term used by the legislature in framing this act as loose, and says that the question should be definitely decided to avoid confusion. He follows an opinion of Judge Cardozo of the Court of Appeals, which in another case incidentally held that the town board constituted the "town authories" under the meaning of the statute.

VERMONT.

The Public Service Commission has ordered the dismissal of a petition of the Central Power Corporation of Vermont with headquarters at Middleburg, for a certificate that "the establishment and maintenance of the proposed corporation will promote the general good of the state." The incorporators under articles of association sought the right to construct and acquire by purchase, lease or otherwise, and to operate power plants, hydraulic works, stations, dams, storage basins, transmission lines and distributing stations within the state. The Commission is of the opinion that the proposed corporation would be endowed with too broad powers, involving the right of eminent domain. Without regard to the latter question, the Commission holds that it would not be for the good of the state to grant any public service corporation a roving charter to operate anywhere within its limits.

The incorporators of the corporation, as given in the petition, are Charles H. Thompson, Montpelier; Francis A. Walker, Barr; Clarence P. Johnson, Lexington, Mass.; Robert L. Ryder, Boston, and Bancroft Abbott, Norwood, Mass.

WISCONSIN.

City Water Company of Merrill—Going Value. In a recent decision involving the rates and service of the Merrill Water Company, the Commission discusses at length the determination of a proper allowance for going value.

In previous cases, the Commission has computed going value solely as the actual cost of building up the business, that is, has computed as closely as possible the amount of the past deficits below reasonable earnings. In the Merrill case, the Commission determines the actual cost and also makes an estimate on the "comparative plant" basis.

The cost of reproduction new of the physical property of the water company now used and useful is found to be $203,666, and the cost of reproduction less depreciation is $177,274. Adding to the depreciated or present value of the physical property an allowance to cover both working capital and going value, the Commission finds that a value of $200,000 may be used as a basis for rate making.

Amount of Past Deficits. From the data for the period from 1888 to 1913, it appeared that the deficits from operation, including a proper amount for depreciation, is $80,895; and including interest on the annual deficits would increase the total to well over $100,000.

"In other words, the operation of the present plant seems to have cost the company more than $100,000 in excess of its receipts."

Comparative Plant Computation. "One very widely advocated method of determining value of the established business of such a plant, i. e., the amount of its going value, consists in summing the present worths of the differences between the future earnings of the existing plant and the estimated future earnings of an imaginary and similar plant, whose construction is assumed to be begun immediately, and which then and thereafter has to undergo the experience of developing a business equal to that already possessed by the one now operating, the two not being considered competitive. This method obviously involves an assumption as to how much more rapidly a plant now about to be built would acquire consumers and revenue than they have been acquired by the plant whose value is being ascertained. The present volume of business would undoubtedly be developed more rapidly by the imaginary or conceptual plant, as it is sometimes called, than was the case of the one under consideration, because the former would begin operation with a larger population in its territory than existed at the time the original works were built."

The Commision estimates the operating expenses, including a proper rate of return, which would be required by the comparative plant.

"In computing the going value of this plant by estimating the cost of reproducing the business (which has actually been developed more or less gradually throughout a period of about 27 years) in accordance with the method hereinbefore alluded to, it is necessary to compare the probable earnings and expenses of the existing plant during the near future years with the estimated probable earnings and expenses during the same years, if the construction of the same plant were only now about to be begun. Obviously, this is somewhat speculative. It would probably be differently estimated by different parties. To be considered reliable such estimates must be made with freedom from bias or prejudice and upon a careful study of all the available facts and circumstances having a bearing upon the result.

"A period of at least five to six years would doubtless be required to duplicate the plant construction and business development that has already been going on for over 27 years. The sum of the present worths of the differences between the net earnings in the two cases, actual and hypothetical, is considered by the authors and advocates of the method to represent the going value of the existing plant."

Making a computation based on numerous assumptions regarding the period of construction of the comparative plant, the probable revenue from public hydrant service and from general service, and the probable earnings of the present plant the Commission states that "the present worths of the differences between the seemingly probable earnings of the two plants considered," shows a "going value" of $12,807.

The Commission concludes: "In addition to the elements of physical property and going value there is also to be considered an allowance for working capital. The addition of a reasonable amount for this purpose brings the total to substantially $200,000."

Denver & Rio Grande Railway Planning to Electrify.—Estimating that a saving of 30 per cent in operating expenses over the heavy grades of the road, the engineers of the Denver & Rio Grande Railway have submitted plans and estimates for their electrification. A report on electrical power sites along the line, together with costs of power furnished by power companies, was included.

NEW APPLIANCES

A Weekly Review of the Latest Developments and Current Information Respecting Electrical and Kindred Mechanical Appliances

The "Sunlight" Projector for Flood Lighting.

The past year has seen an extraordinary development in flood lighting. Originally used for the exterior illumination of buildings, its possibilities for many other purposes have been made manifest by almost each new installation. The demand for equipment specially adapted for the varied applications of flood lighting has produced several types of projector lamps, of which the "Sunlight" flood projector, manufactured by the American Lighting Company, 617 West Jackson Boulevard, Chicago, Ill., has been developed after careful study of all the technical and practical requirements of such lamps.

This study was begun with the idea of lighting theater stages from the upper part of the auditorium, a projector lamp of exceptional power and ease of control being developed for the purpose, which resulted in several very successful installations. A development from this was the addition of color effects and the production of strikingly attractive and novel flood-lighting installations in summer gardens, dining halls, and the like. Before using these lamps in the much larger field of exterior flood lighting, they were practically redesigned to adapt them to the severe requirements of this service. The result was the "Sunlight" projector, which has been used with complete success for a great variety of outside purposes, its construction being such as to make it suitable for many uses by simple adjustment.

Fig. 1.—View Showing Back of "Sunlight" Projector.

Fig. 2.—View Showing Wired-Glass Front of Projector.

Fig. 1 shows the rear and side of the "Sunlight" projector. The case is made of substantial and well protected metal. The lamp used is a 1,000-watt gas-filled 110-volt tungsten lamp with concentrated filament. It is screwed into a mogul porcelain receptacle that is mounted in the hood or cap of the outfit so that the lamp is in a pendent position. This cap can be turned or moved up or down so as to permit turning or raising the filament to the most advantageous position; after the lamp is unscrewed, the cap can be readily entirely removed from the housing to give instant access to the receptacle and circuit terminals. The circuit wires pass into the cap through heavy porcelain bushings.

The back of the lamp with its adjustable reflector-supporting stem can be easily removed bodily, it being secured to the casing by means of screwed bayonet joints. This gives instant access to the reflector and lamp. The front of the lamp, Fig. 2, is likewise quickly removable by loosening similar bayonet joints. This front is made of flat wired clear glass to prevent pieces from dropping down in case of accidental breakage; it is given a number of light vertical cuts with a diamond to prevent uneven expansion and cracking due to heat. Should the front be shattered due to dropping the lamp from some high point or other rough handling, it can be much more readily renewed than the special curved glass fronts used in other projectors.

A metallic reflector is used for all portable projectors. It is made of spun brass carefully silvered on its reflecting side and covered with a special, non-tarnishing protective coating; this has been found to be very durable, permits maintaining the high efficiency of the reflector, and yet can be cleaned with a little care. For permanent installations where the projectors are not exposed to rough usage or violent weather conditions, mirrored-glass reflectors are used. In nearly all cases the reflectors are as true parabolas as it is possible to make them commercially, thus giving a powerfully concentrated beam of light rated at 150,000 candlepower in the center of the beam when used as a flood lamp and as high as 500,000 candlepower when used as a searchlight. In special cases where a very large area is to be lighted from relatively few lamps, the reflectors have a shape between the parabolic and spherical. In all the projectors the concentration or spread of the beam is adjustable by means of the handle at the back of the lamp, Fig. 1. This permits moving the reflector toward or away from the lamp to give the light distribution desired. The entire arrangement is such, however, that in no case does a dark spot appear in the middle of the illuminated field.

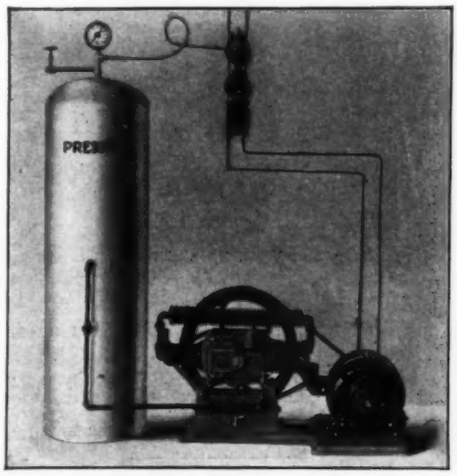
By means of the trunnion and swivel support of the projector, it can be turned to any desired vertical or horizontal angle so as to direct the light to the zone to be illuminated.

The entire projector is well ventilated, inlet openings at the bottom and outlets in the cap giving means for keeping all parts of the outfit cool. Every part of the projector is designed for ready accessibility and quick adjustment, thus making it suitable for mounting on towers or other difficult places, as well as for portable or permanent installations, as has been found in the great variety of cases in which it has been used with completely satisfactory results.

Automatically Controlled Motor-Driven Air-Compressor Plant.

The outfit illustrated herewith has recently been developed by the United States Air Compressor Company, Cleveland, O., for use in garages, factories, air-drill service, etc.

The two-stage compressor is belt-connected to a one-half horsepower single-phase or direct-current motor made by the Robbins & Myers Company, Springfield, O. The tension is maintained on the belt by an automatic belt-tightener. The cylinders of the compressor are opposed and are provided with rings to increase the heat-radiating surface. The connection between the two cylinders is also similarly equipped.



Motor-Driven Air-Compressing Plant.

The outfit is self-oiling and it is necessary to replenish the oil only about once in two months. Every working part runs in oil and no oil cups are used. The bearings are bronze with babbitt lining. All working parts are inclosed to keep out dust. There are no stuffing boxes to cause leakage or require repacking. The body is cast in one piece to insure alinement of the pistons. The valves are steel balls in bronze seats and each pump is equipped with a safety valve to prevent accident from too much pressure. The pump has a capacity of 5,000 cubic inches per minute. The shipping weight is 140 pounds and the floor space required is 14 by 24 inches.

This set is supplied complete with a 30-gallon seamless tank, automatic controller, gauge, valves, compressor, motor, oil trap, safety valve, automatic belt-tightener and belt with all necessary piping shown, all mounted on a large metal subbase.

In addition to the size shown, a larger outfit with a capacity of 15,000 cubic inches per minute can be furnished.

Illuminated Street-Lamp-Changer.

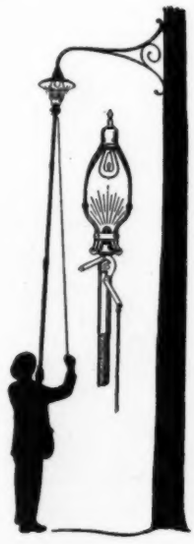
A device for changing series incandescent street lamps from a position on the ground below, with the improved features over former apparatus of being equipped with a means of illuminating the lamp and socket, has been perfected and patented by A. W. Darby, superintendent of the Municipal Electric Light Plant, Holyoke, Mass.

The device consists of a two-pronged clamping tongs made of brass rods, attached to a section of steel tubing, into the lower end of which a jointed wooden pole is inserted. The tubing contains a bull's eye electrical flashlight with dry battery beneath it, and when in use the light is switched on automatically.

The jaws of the tongs are operated by means of a sliding cone, which is projected on the tube by a cam and lever to which a cord about the length of the pole is attached.

One pull of the cord raises the cam, locking the jaws of the clamp onto the socket of the lamp to be extracted. As the jaws are forced together to engage the socket, the light in the tube is switched on, enabling the operator to see clearly what he is doing and where to locate the prongs of the extracting tongs.

In renewing a lamp, the unit is locked into the tongs and the latch-cord, being attached to the opposite lever of the cam, when drawn downward releases the jaws after the lamp has been screwed into position. The bull's eye lamp is simultaneously switched off.



Lamp-Changer and Detail of Head.

The illuminated lamp-changer obviates the necessity of climbing poles or handling apparatus connected with high-voltage circuits at night.

A New Dry Storage Battery.

The extraordinary convenience of the ordinary dry cell has acted as an incentive to inventors to develop a type of storage battery that can be used as freely without danger of spilling or leakage of electrolyte. A new battery of this type has recently been placed on the market by the Venus Electric Lamp Company, 64 Second Avenue, Detroit, Mich.

The Venus dry storage battery is of approximately the same size as the standard No. 6 dry cell, but possesses the capability of being recharged indefinitely. The outer case is of turnplate steel, lined with acidproof material, insuring great durability and rigidity, combined with light weight.

The electrolyte is not in liquid form, but consists of an expensive mineral preparation made up to the company's own formula; it requires no addition of water. It is packed in around and between the cylindrical plates in such a manner as to form a compact, solid mass. The battery conse-

quently is proof against spilling and leaking. A mineral condenser is used at the top of the cell, which checks all tendency of the moisture to escape by automatically condensing and returning same to the battery. This is an exclusive feature of the Venus battery.

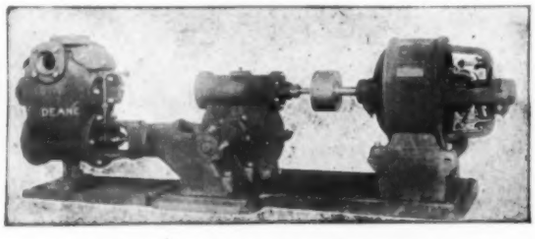
By using the cylindrical type of plate construction it is possible to get a very compact and rigid form of battery, the plates being so tightly packed as to eliminate the danger of short-circuit or distortion. The closeness of the plates, together with the fact that all parts thereof are used to the best advantage, also makes for very high efficiency and capacity, as is evidenced by the relatively high discharging rate of the Venus battery in comparison with its small size.

The capacity of this battery is said to be close to 30 ampere-hours at a discharge rate of 2.5 amperes for nearly 12 hours. This high capacity and discharging rate enables the battery to be used for ignition purposes, for electric head lamps for motorcycles, motorboats, bicycles, and in fact for many other uses which will readily suggest themselves. The charging rate is correspondingly high, or 3.5 amperes, this fully charging the battery in about eight hours.

The Venus battery is claimed to be immune to all the so-called "sicknesses" of the liquid storage battery. This is due to the manner in which the electrolyte is packed between and around the specially designed plates. This construction also largely accounts for the very high efficiency of the battery, as it promotes more effective chemical action on the plates and apparently automatically prevents decrease of capacity, which is not the case with the liquid battery.

Motor-Driven Vacuum Pump for Residence Heating System.

Recently there has been installed in the new residence of Henry Ford, the automobile manufacturer, near Dearborn, Mich., a vacuum heating system in connection with which the pump shown in the illustration is used. In this system a low working pressure throughout the entire heating system is made possible by introducing a vacuum in the return lines. A Deane 8-inch by 7-inch power vacuum pump marketed by the International Steam Pump Company, Holyoke, Mass., takes care of the entire system having about 10,000 square feet of radiating surface. It is driven by a Westinghouse 7.5-horsepower motor through a worm drive which eliminates noise usually accompanying spur-gear drive and makes a very quiet operating pump suitable for residence and office work or other places where noise is objectionable.



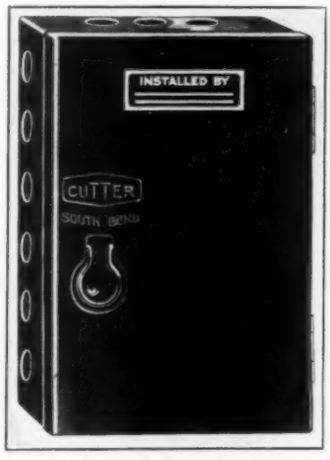
Electrically Driven Vacuum Pump.

Cutter Cutout and Service Boxes to Bear Names of Contractors Installing Them.

Starting from the premise that satisfied customers are the electrical contractors's best asset, the George Cutter Company, South Bend, Ind., has inaugurated a selling campaign on the company's steel rivetless cutout boxes, that offers the contractor an opportunity to gain a certain amount of free publicity by adding his name in permanent form to every installation the contractor undertakes.

"Let your name on the box guarantee your job" is the message the manufacturer conveys to the contractor. As a rule, the only exposed part of an electrical installation is the cutout box. Granted that the box itself is of high quality, the manufacturer points out that this is the logical place to present the contractor's signature as a guarantee of the quality of other parts of the installation not exposed to view. Hence the new thought has been brought out by the George Cutter Company that a gold-leaf name plate on every cutout and service box, showing it was installed by a high-class electrical contractor, will mean a permanent advertisement, making the contractor known to and giving him the confidence of owners, architects, engineers and inspectors. There is no charge made for affixing the name plates on Cutter boxes.

Cutter rivetless steel cutout boxes are formed up from a single piece of sheet steel and electrically welded. Doors overlap and fit tightly, making the boxes dirt and dustproof. A countersunk ring handle is provided. Highly polished Japanned finish is in keeping with the quality of the boxes. The George Cutter Company has published an attractive folder describing the line and giving details of the name-plate offer.



Cutter Box With Special Name Plate.

Electrical Equipment of the Inland Steel Company's New Mill to Include a 15,000-Horsepower Reversing Motor.

The addition to the plant of the Inland Steel Company at Indiana Harbor, Ind., now in course of erection will include all the advantages of electric drive throughout, including the main rolls, and the electrical equipment will incorporate very striking features. It will be practically a complete steel plant in itself. The addition will consist of open-hearth furnaces, blooming and finishing mills.

About two years ago, the Inland Steel Company installed electrical apparatus in its plate and steel mills, the operation of which was so successful that when the decision was made to erect a new mill, electric drive was the only form of motive power considered.

Accordingly a contract was recently awarded the Westinghouse Electric & Manufacturing Company for the complete electrical equipment of the mill, including two 5,000 kilowatt, 25-cycle, 2,400-volt turbogenerators complete with surface condensers, exciters and switchboards; two 1,000-kilowatt synchronous motor-generator sets; one 15,000-horsepower direct-current motor equipment; two 8,000-horsepower motor equipments; also several thousand horsepower of auxiliary apparatus. The contract prac-

tically doubles in value any ever given by a steel company for electrical equipment and is exceeded in total horsepower, but not in size of units, only by one other installation. It aggregates close to $1,000,000.

This installation will doubtless be watched with considerable interest by steel-plant engineers and operators on account of the many novel features designed by the Westinghouse engineers.

The 15,000-horsepower direct-current motor will be direct-connected to a 40-inch reversing blooming mill, receiving its power from the generator of a flywheel motor-generator set. The direction of rotation of this mill motor is to be obtained by means of voltage control of the generator supplying it with current.

The structural mill consists of one 32-inch reversing roughing mill, and one 28-inch finishing mill of three three-high rolls. Each mill is driven by an 8,000-horsepower direct-connected, direct-current motor and the scheme of control is the same as mentioned for the blooming mill. One flywheel motor-generator set with a generator unit for each motor supplies the power for the mills and by a special system of control and design of apparatus, the power taken from the line is equalized to practically a constant load with variations of not more than 10 per cent plus or minus, although the load on the mill motors will vary from several thousand horsepower in one direction to several thousand horsepower in the opposite direction several times a minute.

Fig. 1.—Motor With Countershaft Base.

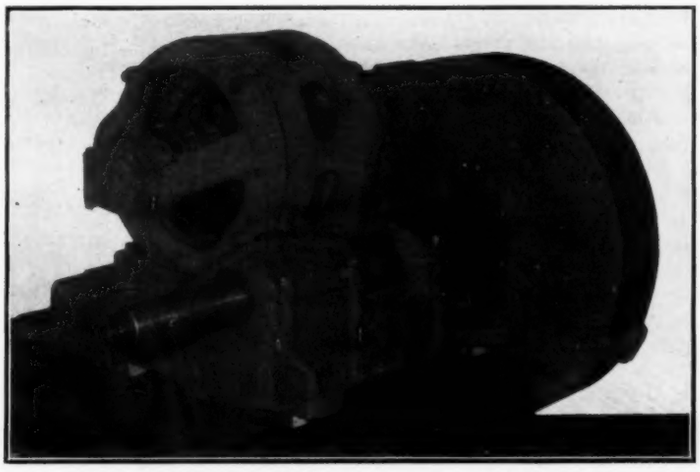


Fig. 2.—Motor With Another Type of Countershaft Base.

Energy for the auxiliaries, most of which are direct-current motor drive, is to be supplied from the two 1,000-kilowatt synchronous motor-generator sets.

Countershaft Induction Motor with Base.

Because of their strong and rigid construction the countershaft induction motors shown herewith are specially adapted for use where the service conditions are severe. In both cases a standard Crocker-Wheeler induction motor is mounted on a massive base which serves as a support for the countershaft bearings. This method of construction results in a low center of gravity. Perfect alinement of the countershaft bearings is insured by mounting them as shown and by using a semi-self-alining design of bearing. By using this base construction it is possible to have the countershaft bearings the maximum distance apart, thus taking care of the heavy thrust that occurs at the pinion end of the countershaft.

In the case of the motor shown in Fig. 1, the base has a bearing support cast integral with it at each end. These bearing supports extend for a considerable distance both inside and outside of the base. Additional rigidity is given each of these supports by the use of two webs or braces located on the outside surface of the base. The bearings proper are castings designed to hold the journal box and to have an oil well in the lower portion. The bearings are securely held in the accurately bored bearing supports of the base. Endwise motion is prevented by a special form of set screw extending through the support into a corresponding hole in the bearing. The oil wells are tapped for oil gauges and drain plugs and are fitted with dustproof sight-hole covers. The ends are, in addition, protected by tightly fitting dust covers.

The journal box fits into the bore of the bearing housing just described, as accurately as do the journal boxes of the rotor in the motor shields, the construction being similar. The journal box is maintained in position by a set screw projecting into a drilled hole in the top.

Oil-ring lubrication is used on all bearings. The oil grooves used to distribute the oil carried up by the rings are so located that no matter in what direction the pressure may come on the bearing, the oil will always be carried between the shaft and the journal box, thus maintaining the oil film without which perfect lubrication and freedom from wear is impossible. In addition the design of the bearings is such that while dust and dirt cannot work into the bearings, the oil cannot get out.

The pinion on the rotor shaft and the gear on the countershaft are inclosed in a two-part gear case, each half being securely bolted to the base of the motor. A hand hole with a self-closing cover is provided in one-half of the gear case to render the gearing readily accessible for inspection and lubrication. When it is desired to attach the motor to the ceiling, or on a wall, the motor shields and bearings and the two countershaft bearings can easily be rotated through the necessary angle, so that the oil rings in the four bearings will operate properly.

Fig. 2 shows another type of construction employed. The base is more massive and the countershaft is mounted to one side of the base of the motor. Split countershaft bearings are employed, the lower halves of which are cast integral with the base. The caps are held together by means of four bolts. Otherwise the general construction is similar to that employed in the type of motor previously described.

As both types of construction permit the use of a standard induction motor, the owner of a standard plain motor can easily change it at any time into a geared countershaft machine by purchasing the countershaft parts. These countershaft motors are being made by the Crocker-Wheeler Company, Ampere, N. J.

INDUSTRY ACTIVITIES

Woodmansee & Davidson, consulting engineers, have moved their offices from 1048 First National Bank Building to 784 Continental & Commercial National Bank Building, Chicago.

De La Vergne Machine Company, 1185 East 138th Street, New York City, is sending out neat calendars for 1916. The type FH De La Vergne crude-oil engine is pictured and its extraordinary economy is pointed out. The monthly calendar sheets are conveniently arranged to show not only the current month, but also the last and next month.

Phillips Insulated Wire Company, Pawtucket, R. I., has published a very attractive calendar for 1916, printed in colors and presenting a bird's-eye view of the company's large factory, and also carrying embossed trade-marks of the companys product. The calendar is of convenient form and arrangement, and will be popular with all who receive it.

Queen-Gray Company, Philadelphia, Pa., has issued Bulletin E7, dealing with Wheatstone bridges, low-resistance bridges, ohmmeters, resistance boxes and standard resistances. The instruments and apparatus illustrated and described are chiefly for resistance and conductivity measurements of high accuracy. Several types are described in considerable detail, and the construction of parts of the apparatus specially explained.

General Electric Business.—Bookings of the General Electric Company, Schenectady, N. Y., since the beginning of the new year have continued at the same high rate as in the latter part of 1915, when orders averaged about $3,000,000 weekly. This is exclusive of "special export business," the term applied to the company's war orders. Unless an unexpected change occurs the General Electric Company will this year close the greatest volume of contracts ever taken on its books in a single year.

The Electrose Manufacturing Company, Brooklyn, N. Y., is distributing several leaflets and a wall card preliminary to the issuance of its general catalog. The bulletins illustrate and describe a few types of the company's high-tension insulators, insulating connectors and parts, while the wall card shows a photograph of the fighting top of the United States battleship *New York* taken from the Manhattan Bridge. A number of Electrose insulators have been installed on this man-of-war.

Clarence W. Marsh, consulting and chemical engineer, has established offices at 201 Devonshire Street, Boston, Mass. For the past 12 years Mr. Marsh has been chief engineer and special investigator for the Hooper Electrochemical Company and the Development & Funding Company of New York City, and he is now prepared to render service relating to the chemical and allied industries, especially to questions of the manufacture of electrolytic caustic soda, bleaching and chlorine products.

The Richardson Scale Company, Passaic, N. J., has published bulletin No. 101, devoted to illustrations and descriptions of its appliances and apparatus for the automatic weighing of coal and water in power plants. As a contribution to technical literature the bulletin is worthy of a prominent place in the files of every engineer. The illustrations are well presented, the diagramatic suggestions are handled to the best advantage and the typographical arrangement and printing leave nothing to be desired.

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has just received an edition of 200,000 copies of an eight-page folder describing the Cutler-Hammer magnetic gear shift for gasoline automobiles. The folder is for general distribution. This automatic means of gear shifting has been adopted by the Pullman Car Company of York, Pa., and as optional by the Winton Motor Car Company of Cleveland, and caused considerable comment when it was exhibited at the New York and Milwaukee automobile shows.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has recently issued two leaflets on alternating-current switches. Leaflet 3551-A describes Type F alternating-current magnet switches which have been designed to fulfill the severest requirements of industrial service. Details of construction, operating characteristics and illustrations of mounted switches are given. Leaflet 3849 describes and illustrates Type EA alternating-current low-voltage switches. Diagrams of typical connections are given and the construction of the board thoroughly described.

The Wesco Supply Company gathered its entire staff of traveling salesmen for annual conference at its offices, St. Louis, Mo., January 4 to 7. Representative speakers were secured by Sales Manager F. D. Phillips from the manufacturers of the most important lines distributed by the company, and these men outlined the sales policies of each manufacturer for the benefit of the Wesco salesmen. The results of these talks will undoubtedly be shown by greater sales during the year. The conference, deemed a great success, was closed with a banquet given by President Charles Scudder at the St. Louis Club and a ball given by the Wesco Mutual Benefit Association.

The Electric Storage Battery Company, Allegheny Avenue and Nineteenth Street, Philadelphia, Pa., announces that its representative and distributor in southern California, the Kay & Burbank Company, of Pasadena, has found its business has increased so much as to necessitate opening an Exide battery depot and service station in Los Angeles. The new establishment is located at Eleventh and Figureoa Streets in the heart of the automobile district. The front part of the building is occupied by the office and a large battery stockroom, which carries one of the largest stocks of batteries and parts on the Pacific Coast. In the rear of the building with an entrance from Eleventh Street is housed the battery service department and the electrical department where electric vehicle, ignition, starting, lighting and magneto work is taken care of.

Page & Hill Company, Minneapolis, Minn., announces that it has secured the services of W. B. Foshay as sales engineer, with headquarters at the main office of the company. Mr. Foshay is well known in electric lighting circles, having been connected with various lighting companies. He began his work with the United Gas Improvement Company, and was later manager of the Hutchinson (Kan.) Electric Light Company, Fort Dodge (Iowa) Electric Light Company and the Wichita (Kan.) properties. After leaving Wichita he went to Walla Walla, Wash., and took charge of the central station in that city, becoming district manager of a group of plants in the states of Washington and Oregon, covering a territory of 90 miles. Later he opened an office as consulting engineer in Portland, Ore., but received so attractive an offer from Page & Hill Company that he decided to enter the cedar-pole field. Mr. Foshay's experience in the electric lighting business will enable him to do ex-

cellent work for the company, and his acquisition rounds out a most complete organization.

National Lamp Works of General Electric Company has issued through its Engineering Department, Bulletin 26 entitled "The Mazda Lamp in Photography." The bulletin presents in simple language such data and information in regard to the Mazda lamp and its application to the processes of photography as will assist photographers in their work, and acquaint the electrical public with the principles involved. The first part of the bulletin is devoted to a description of the photographic process and its relation to the Mazda lamp. Particular attention is paid to the special photographic-blue-bulb Mazda C lamp and its application to the lighting of portrait and motion-picture production studios. The use of these lamps for taking interior views, for copying, printing, enlarging, and photomicrography is likewise discussed. Copies of this bulletin may be obtained from the Engineering Department, National Lamp Works, Nela Park, Cleveland, O.

Cutler-Hammer Clutch Company, Milwaukee, Wis., has just issued Bulletin 12 describing lifting magnets. This 24-page bulletin contains over 40 illustrations and interesting information concerning the design, application and cost of handling various materials. Illustrations are reproduced from a moving-picture film showing a Cutler-Hammer High Duty magnet handling a skull-cracker ball for breaking scrap. An increase in lifting capacity of 20 to 50 per cent for all sizes of the new High Duty magnets is claimed. The same company has also issued a circular that briefly describes the Cutler-Hammer magnetic saparator pulley, which is designed to remove stray pieces of iron or steel from diamagnetic substances. The magnetic saparator is used to protect crushers from injury and in such industries as sugar refineries to remove small particles that detract from the purity of the product.

Western Electric Company.—Business of the Western Electric Company last year approximated $62,000,000, compared with $66,000,000 in 1914, according to a statement by Gerard Swope, vice-president. In a message to the employees of the company just before the close of 1915, Mr. Swope said in part: "The year 1915 started out under poor business conditions, this country not then having commenced to feel the impetus which came from war business. Our business activity, both in our factory and in the distribution of all our merchandise, was accordingly much curtailed. During the year, however, conditions gradually improved, due to the larger portion of the world's requirements in foods, raw material and manufactured products, which is being supplied by the United States. This could not help but have its indirect effect upon other industries, and has so stimulated the telephone industry and business in general that during the latter part of the year the activities of our factory and our business were much increased. We will, therefore end the year with sales larger than we had anticipated. We expect the business for 1916 to be somewhat greater than for the year 1915."

The Esterline Company, Indianapolis, Ind., reports that its business is continually growing and prospects very bright. The graphic-instrument department of the company made sales during December, 1915, to the following companies: Allis-Chalmers Manufacturing Company, Bell Telephone Company of Pennsylvania, Carbon Purchasing Company, Chicago, Burlington & Quincy Railroad Company, Chicago Portland Cement Company, Coal Products Company, Commonwealth Edison Company, Consumers Power Company, Cutler-Hammer Manufacturing Company, Detroit-Edison Company, Diamond Portland Cement Company, Duquesne Light Company, E. I. Dupont de Nemours Company, Eastern Michigan Power Company, Electrical Equipment Company, Montreal; Elizabeth Steel Magee Hospital, Equitable Office Building, Federal Sugar Refining Company, W. W. Geisse, Goodyear Tire & Rubber Company, Indianapolis Heat & Light Company, Lake Charles Railway, Light & Water Works Co., Lowell Textile School, Ludwig Hommel & Company, Merchants Heat & Light Company, Indianapolis; Mond & Nickel Company, Toronto; National Tube Company, New York Central Railroad Company, Northern Electric Company, Montreal; Northern Electric Company, Toronto; Northwestern Electric Company, Northwestern Electric Equipment Company, Ohio State Telephone Company, Patterson-Sargent Company, Pacific Portland Cement Company, Philadelphia Electric Company, Pittsburgh Coal Company, Pittsburgh Crucible Steel Company, Prest-O-Lite, Public Service Railroad Company, Record Electrical Company, Manchester, England; Remy Electric Company, Roessler-Hasslacher Chemical Company, San Joaquin Light & Power Company, Sayles Finishing Company, Scranton Electric Company, Scranton Railway Company, Seymour Power Company, Solvay Process Company, Strathmore Paper Company, Superintendent of Construction, Pittsburgh; Taylor Instrument Company, Tennessee Coal & Iron Company, Terre Haute, Indianapolis & Eastern Traction Company, Toronto Light Company, Toronto; United States Navy Pay Office, United States Smelting Company, West Penn Railway Company, Westinghouse Electric & Manufacturing Company, and Whiting Foundry Equipment Company.

The Standard Underground Cable Company announces the following promotions and rearrangements in its general office and factory staffs: In the general offices P. H. W. Smith, formerly vice-president with duties of general sales manager, becomes vice-president and assistant general manager under President and General Manager J. W. Marsh, and as such will have general oversight of manufacturing and sales activities of the company, with headquarters at Pittsburgh, as formerly. Charles W. Davis, formerly manager of the company's central sales department, general superintendent of construction and manager of the accessories department, becomes vice-president and general sales manager. Mr. Davis' connection with the company dates from 1900, and his former duties and experience have been both broad and long with the Standard Company. Arthur A. Anderson, also for many years connected with the company's sales organization at Pittsburgh, has been made manager of the central sales department in the Pittsburgh district. A. F. Hovey has been made manager of the construction department and J. H. Lytle, manager of the accessories department. In the factory organization C. C. Baldwin, formerly superintendent of the wire and rod mill and weatherproof and magnet-wire departments and of the brass and tubing departments at Perth Amboy, N. J., has been made a vice-president of the company and general manager of the Perth Amboy plant. Mr. Baldwin is well known in the electrical industry as an expert wire and rod-mill man, having built several well known wire and rod mills before becoming connected with the Standard Company in 1903. H. W. Fisher continues as chief electrical engineer of the company, and in addition, becomes manager of the lead-cable works and rubber wire and cable factories, under the assistant general manager and president. He is also made an officer of the company by virtue of his appointment as assistant secretary, but will be located at Perth Amboy, as heretofore. Other advancements at the Perth Amboy plant are: Tracy D. Waring will be assistant manager of the lead-cable works and of the rubber-wire factory, Albert C. Meyers will be superintendent of the rubber-wire factory, and E. J. Waring will be assistant purchasing agent, in addition to his former duties as business manager at the plant. At the Pittsburgh factory Charles Barbour is given the title of manager of the Pittsburgh factory, and also of the plant of the Standard Underground Cable Company of Canada, Limited, at Hamilton, Ont., Canada, the duties of which positions he has performed for some time.

CURRENT ELECTRICAL NEWS

ATLANTIC STATES.

BRIDGEWATER, MASS.—The Edison Electric Illuminating Company will build an addition to its plant here.

NEW HAVEN, CONN.—The United Illuminating Company is enlarging its powerhouse and will install additional equipment.

NEW LONDON, CONN.—This city is to have a white way and other lighting improvements. The Connecticut Power Company furnishes power.

SOUTH NORWALK, CONN.—Ornamental lighting and municipal power plant improvements are being considered by the city.

ALBANY, N. Y.—The Public Service Commission has authorized the issue of $541,950 in securities of the Northern New York Utilities, Inc., with which to pay certain debts, provide for new extensions and absorb the Cape Vincent municipal plant, the Chaumont Electric Light Company and the Thousand Islands Electric Light & Power Company, and exercise eight new town franchises.

DUNDEE, N. Y.—A power line will be constructed between this city and Lakemont. Address E. L. Bailey.

SENECA FALLS, N. Y.—The Seneca Power Corporation has been incorporated by Henry R. Micks, Paul B. Kendig and others. The corporation will build an electric powerhouse at the new dam of the barge canal, which will be of sufficient magnitude to generate 8,000 horsepower for use by manufacturing interests. The work of building will begin without delay.

ALBURTIS, PA.—The Lehigh Valley Light & Power Company, of Allentown, Pa., has been granted a franchise to supply power in this city. Lines will be extended from Macungie, a distance of about three miles, and it is expected that work will be started shortly.

NEW CASTLE, PA.—Applications for charters in various townships of Lawrence, Mercer and Beaver Counties were filed in Harrisburg in behalf of the Mahoning & Shenango Railway & Light Company. The purpose of the charters is to enable the company to give additional local service in the townships and to permit it to tie together by extensions of its transmission systems the three powerhouses of the system. Address general manager.

PITTSBURGH, PA.—The Baltimore & Ohio Railroad Company will build a powerhouse on Second Avenue.

POTTSVILLE, PA.—Charters giving the Eastern Pennsylvania Light, Heat & Power Company the right to do business in eight nearby townships have been granted.

TROY, N. C.—The Smitherman Power Company has been incorporated with $300,000 capital to generate and distribute electrical energy for light and power.

PALATKA, FLA.—The Southern Utilities Company of Jacksonville is planning to install generating equipment at plant of Palatka Ice Company to furnish, power day and night.

NORTH CENTRAL STATES.

GENEVA, O.—The city contract for electric lighting with the Electric Light & Power Company will soon expire and a municipal plant may be installed. Address city auditor.

SPRINGFIELD, O.—Manager Weare Parsons, of the Springfield Light, Heat & Power Company, stated that the installation of new equipment at the plant will start about March 1.

URBANA, O.—The Urbana Light Company is investigating the extension of its lines to Mingo and Cable, as well as intermediate points, to serve industrial plants and domestic consumers.

WILMINGTON, O.—Bids will be received until February 17 on the construction of the new courthouse and jail, including the electrical equipment. Weber, Werner & Adkins of Cincinnati prepared the plans, which can be obtained of them or of the County Auditor. A deposit of $20 is required. Bids may be submitted on separate branches of the work. L.

WILMINGTON, O.—A proposition to construct a traction line from Wilmington to Xenia, to connect with the Dayton and Xenia line will be considered by the local Chamber of Commerce. Address J. W. Sparks.

YOUNGSTOWN, O.—Damage to the amount of about $3,000 was done to the boulevard lighting system in course of construction in East Youngstown during the labor troubles there. The Youngstown & Sharon Light Company, which is handling the work, reports that many of the standards and transformers were broken, while about 75 meters were lost as well as other equipment which will have to be replaced. L.

YOUNGSTOWN, O.—The Mahoning & Shenango Valley Electric Light Co., in connection with the extension of its service to a number of towns in this section, will charter 14 or 15 separate companies in the several towns for that purpose. L.

YOUNGSTOWN, O.—The Youngstown & Niles Interurban Railway is planning to extend its line from Niles to Warren.

ANDERSON, IND.—Mayor J. H. Mellett announced that $100,000 would be spent during the year on new equipment for the municipal light plant.

EVANSVILLE, IND.—The Evansville & New Harmony Traction Company has been organized to construct a new line to extend to Poseyville, Cynthiana, Owensville and New Harmony. Address General Manager Siebert.

NEWCASTLE, IND.—Following the lead of other cities in the state in an effort to obtain lower light and power rates the city will soon go into the retail power business. With the expenditure of $40,000 more it is declared that the city plant can take care of the city's business. Address city clerk.

SEYMOUR, IND.—A new power company here is the answer of the city to the refusal of the Inter-State Public Service Company to reduce its rates for light and power. A 25-year franchise for the new company, which will be known as the Commercial Electric & Power Company, has been asked by the City Council. Address city clerk.

ALLENDALE, ILL.—The Council is making plans to secure electric lighting. Address town clerk.

BASCO, ILL.—Plans have been laid for the installation of electric lights. Address W. O. Fisher.

BELLEVILLE, ILL.—Plans for a white way have been completed. Address W. C. Wolf, city engineer.

DECATUR, ILL.—City officials are considering the installation of a new dynamo at the municipal light plant and ornamental lights on Main Street. The city engineer is preparing estimates.

GALESBURG, ILL.—A new lighting system for this city is being urged by John Walsh, superintendent of lights.

IVESDALE, ILL.—The Council has granted to the Bement Electric Light & Power Company a franchise to build and operate an electric light and power system in Ivesdale.

JOLIET, ILL.—The Joliet & Eastern Traction Company has completed plans to extend its line from Joliet to Hammond, Ind. Address general manager.

MURRAYVILLE, ILL.—A stock company will be organized to furnish electric lights. Address John Brant, Bushnell, Ill.

PRAIRIE DU ROCHER, ILL.—Bonds have been voted for the installation of electric light plant. Address town clerk.

SARDORUS, ILL.—The Central Illinois Public Service Company may extend its lines from Tolono to this city. Address Fred Holl.

OWOSSO, MICH.—C. T. Babcock and W. A. Bahlke of Alma were here to attend a meeting of the Union Telephone Company, at which an expenditure of $38,300 was authorized for the reconstruction and extension of lines in the southwestern part of the city.

CHIPPEWA FALLS, WIS.—The Wisconsin-Minnesota Light & Power Company may build an electric railway to St. Paul. Right of way for a transmission line is now being secured.

SHEBOYGAN, WIS.—Plans are being prepared for a new county central power plant costing $5,000. Address John Olson, county commissioner.

SHEBOYGAN FALLS, WIS.—The Common Council has ordered the installation of an ornamental lighting system on North Eight Street from Jefferson to Michigan Avenue.

FLOODWOOD, MINN.—The village council has granted a 30-year franchise to the Cloquet Electric Company.

OSKALOOSA, IOWA.—The Oskaloosa Traction & Light Company will rebuild the power lines in the business district.

NEW VIRGINIA, IOWA.—J. F. Smith of Lorimor has petitioned for a franchise to establish an electric light plant.

WAUKEE, IOWA.—The Council plans

to install a $7,000 electric plant. Address G. C. Jones, mayor.

BLUE SPRINGS, MO.—The Council plans to install 33 electric street lights. Address town clerk.

HIGGINSVILLE, MO.—The City Council has decided to submit to the voters a proposal to issue bonds to enlarge the municipal power plant. Address town clerk.

KANSAS CITY, MO.—The Industrial Council has approved a movement for a municipal light plant. Address city electrician.

KANSAS CITY, MO.—The Ford Motor Company is having plans prepared for a power plant. C. C. Mead is local manager.

COLUMBUS, KANS.—The Oklahoma & Interstate Railway Company is planning to build an interurban line from this city to Galena and to Commerce. John R. Rose of Oklahoma City is president of the company.

LITTLE RIVER, KANS.—Bonds to the amount of $16,000 have been voted for an electric light plant. Address Ray Jack.

ZENDA, KANS.—A meeting of the township was held preparatory to putting in a $5,000 light plant. Local capitalists will build the plant. Address Dr. C. E. Phillips.

DAWSON, NEB.—The Dawson Electric Light & Power Company will build a transmission line to Humboldt.

FAIRBURY, NEB.—The Lincoln Telephone & Telegraph Company will soon rebuild their Fairbury lines and install a modern switchboard to cost about $10,000. The estimated cost of rebuilding in the city is $65,000.

HURLEY, S. D.—The proposition of purchasing the local electric light system and authorizing the issuance of $10,000 in bonds for payment will be submitted to the voters. Address city clerk.

SOUTH CENTRAL STATES.

DIXON, KY.—The City Council has arranged with the Clay Light & Power Company of Clay, Ky., to furnish electricity. The company will construct an eight-mile transmission system.

MURRAY, KY.—The City Council has voted to submit a bond issue proposition for a municipal lighting plant to the voters.

PROVIDENCE, KY.—The $20,000 municipal lighting bonds have been sold to Weir, Roth & Company of Cincinnati at a premium which will be sufficient to produce at the rate of $106. The bonds will draw six per cent interest for 20 years.

RUSSELLVILLE, ALA.—The Sloss-Sheffield Steel & Iron Company is planning to build an electric power plant here at a cost of about $50,000.

GRENADA, MISS.—An ornamental lighting system on the principal streets is contemplated. Address mayor.

LAHOMA, OKLA.—The Enid Electric & Gas Company, of Enid, Okla., will construct a transmission system to furnish light and power to Lahoma.

TUTTLE, OKLA.—The city is considering propositions for the installation of electric light plant. Address mayor.

BOWIE, TEX.—E. P. Turner, president of the Dallas Northwestern Traction Company, attended a mass meeting of Bowie citizens and residents along the proposed route through Montague County. At this meeting $3,000 was subscribed to be used in making a survey of this road from Bowie to Krum to connect with the route already surveyed from Krum, via Denton to Dallas.

BROWNSVILLE, TEX.—Electric street car service has been inaugurated here. There are three miles of trolley line in operation and plans are under way for an extension. A franchise for an electric street car line across the Rio Grande to Matamoros, Mexico, may be acted upon soon.

BRYAN, TEX.—The city is considering the installation of 54 ornamental light poles on Main Street.

COMANCHE, TEX.—Rapid progress is being made on the transmission line being built by the Texas Power & Light Company from Brownwood to Comanche, a distance of about 30 miles. The line will be 22,000 volts and will also serve the town of Blanket.

DALLAS, TEX.—Extension of time on the franchise for both the Denton-Krum and the Cleburne-Glen Rose interurbans was granted in the County Commissioners' Court on application of E. P. Turner, president of the Dallas Northwestern and Dallas Southwestern Traction Companies.

DALLAS, TEX.—Property owners on Akard Street have filed a petition with the Board of City Commissioners asking for the installation of an ornamental lighting system.

DALLAS, TEX.—The City Commissioners have passed through first reading an ordinance granting the Dallas Standard Traction Company a 20-year franchise in Mount Auburn.

MARBLE FALLS, TEX.—M. M. Barry, lessee of the water and light plant here, will install new machinery and make other improvements.

MARLIN, TEX.—The Marlin-Temple Interurban Promotion Company has been organized with principal office here to construct an interurban electric line between Marlin and Temple, about 35 miles. Right of way is now being secured. It is stated by W. A. Patrick, head of the project, that financial arrangements for the construction of the line have been made.

SHERMAN, TEX.—Work has been started on the rebuilding of the Texas Traction Company substation near Sherman, which recently was destroyed by fire.

TYLER, TEX.—F. C. Cotton of Denver, Colo., has purchased the Tyler electric street railway system from J. W. Fitzgerald and associates. He will install new machinery in the power plant and extend the lines. Mr. Cotton has also purchased the street railway system of Cleburne from John W. Floore. The property will be improved.

WESTERN STATES.

CASA GRANDE, ARIZ.—The City Council has taken steps towards constructing a municipal electric light plant out of the proceeds of a $35,000 bond issue.

PHOENIX, ARIZ.—The State Corporation Commission has granted the Phoenix Street Railway Company 18 months' time for the company to rebuild its system.

WICKENBURG, ARIZ.—P. M. Jewett, who recently purchased the local electric plant, is moving part of the equipment to Lynn Creek, where he expects to install a lighting system.

LOGAN, UTAH.—Application has been made to the state for the water power rights in Logan Canyon by D. C. Bridge, who probably will erect an hydro-electric plant.

JULIAETTA, IDAHO.—C. J. Martin & Son, proprietors of the electric light plant here, have agreed to make improvements in order to give 24-hour service.

BREMERTON, WASH.—Plans have been received from Washington, D. C., for the construction of a high power radio station at Keyport, for which the last Congress appropriated $40,000. According to the Commandant at the Puget Sound Navy Yard, $10,000 of this amount must be expended by July 1, 1916. Plans provide for a station consisting of three towers, plant and equipment to cost completed $125,000. O.

COUPEVILLE, WASH.—The Coupeville Electric Light plant, owned by W. C. Cheney, has been sold to H. E. Wood, of Langley, Wash. Reported the new owner will make improvements and extensions to the existing plant at once. O.

HOOD RIVER, ORE.—Plans for the construction of an electrical power plant and dam on Hood River, near this city, to cost $40,000, are being seriously considered by the Farmers Irrigation Company of Hood River. August Guignard, Hood River, president. O.

OSWEGO, ORE.—The Oswego Lake Water, Light & Power Company has petitioned the County Commissioners for a 25-year franchise to maintain poles carrying power and light wires on the county roads near Oswego.

ALTURAS, CAL.—The Alturas Electric Light & Power Company intends to install an auxiliary plant here and extend its lines 30 miles to Hess Mine.

LOS ANGELES, CAL.—Out of the $4,000,000 bond issue approved by the State Railroad Commission granting the Pacific Light & Power Company authority to issue that sum the company intends to use $1,200,000 for extensions and improvements.

PARADISE, CAL.—The Pacific Gas & Electric Company will build a transmission line from its Centerville powerhouse to this city, a distance of 20 miles.

REDDING, CAL.—The City Electrician has been authorized to purchase materials for a new street lighting system.

TROPICO, CAL.—The City Council is considering the possibility of municipal ownership of the local electric plant.

TULARE, CAL.—A new conduit system for the city electroliers is being considered by the City Council.

NEW PUBLICATIONS.

ELECTROLYSIS.—The Bureau of Standards, Washington, D. C., has issued Technologic Paper No. 52 dealing with "Electrolysis and Its Mitigation," by E. B. Rosa and Burton McCollum. The six parts deal with an introduction, general considerations, methods applicable to pipes, to railway negative returns, regulations and summary.

SOUTHWESTERN POWER.—Southwestern Power & Light Company, a subsidiary of the American Power & Light Company, has issued a 68-page report giving detailed financial and physical data pertaining to the company and its operating subsidiaries and many photographs of cities and industries served and of properties owned.

CANADIAN COAL.—The Department of Mines of Canada has issued "The Production of Coal and Coke in Canada During the Calendar Year 1914," giving statistics by provinces.

FINANCIAL NOTES.

Consumers Power Company of Michigan, a subsidiary of Commonwealth Power, Railway & Light Company, has sold to Harris, Forbes & Company, New York City, $1,090,000 first-mortgage five-per-cent bonds.

Winnipeg Electric Railway Company has sold to William P. Bonbright & Company, New York City, $750,000 six-per-cent two-year collateral trust notes, which are being offered at par. Gross of the company for twelve months ended October 31, 1915, was $3,498,397 and net $978,065.

The Crocker-Wheeler Company, Ampere, N. J., has declared a quarterly dividend of 1.5 per cent on the common stock and the regular quarterly dividend of 1.75 per cent on the preferred stock, payable January 15, 1916, to stockholders of record at the close of business December 31, 1915.

The Electric Investment Company, of Boise, Idaho, represented by F. F. Johnson, of Boise, at public auction recently purchased all the property and holdings of the Great Shoshone & Twin Falls Water Power Company, operating in Southern Idaho, at a price of $2,000,000. This price was the minimum price set by the United States District Court after the company had passed into the hands of receiver in November, 1914.

Chicago Railways Company has sold to Harris, Forbes & Company an additional $1,500,000 first-mortgage five-per-cent 20-year bonds, making the total amount of these bonds outstanding $54,455,000. Chicago Railways Company's 59 per cent of the net of Chicago Surface Lines for the year ended November 30, 1915, was $6,415,614, equivalent to a balance of $3,692,864, after providing for interest on the first-mortgage bonds. Gross of Chicago Surface Lines for the year was $31,405,191, with net of $10,873,922.

J. P. Morgan & Company has purchased from the American Telephone & Telegraph Company $50,000,000 4.5-per-cent, two-year notes. Some of notes are direct obligations of the American Telephone & Telegraph Company and the others are obligations of its subsidiary companies, endorsed and guaranteed by the American Telephone Company. It is understood that practically all of these notes have been retained by the Morgan firm and their associates at an investment and will not be offered to the public. The American Telephone & Telegraph Company has done no financing during the past year. Construction at the rate of about 60 per cent of normal was taken care of out of existing resources. In 1916 the company expects to resume construction on normal lines established by the experience previous to the European war. To finance the associate companies this will require about $25,000,000 of new money. At least $30,000,000 of the new notes will be the application of the associate companies with the endorsement of the parent company, and the remainder the direct application of the American Telephone & Telegraph Company. The proceeds of the $50,000,000 new Telephone notes will take care of the maturity in April and May of $26,325,000 two-year, five-per-cent notes of several of the subsidiaries. The balance or, say, $23,000,000 will provide for new construction in 1916 and 1917.

Dividends.

	Term	Rate	Payable
Cities Service, pf.	M	0.5 %	Feb. 1
Col. Ry., Pw. & Lt., pf. Series B	Q	1.25%	Feb. 1
Col. Ry., Pw. & Lt., com.	Q	1.25%	Feb. 1
Crocker-Wheeler, pf.	Q	1.75%	Jan. 15
Crocker-Wheeler, com.	Q	1.5 %	Jan. 15
Elec. Bond & Share	Q	2 %	Jan. 15
Elec. Bond & Share, pf.	Q	1.5 %	Feb. 1
Elec. Util., pf.	Q	1.25%	Jan. 15
Lew'n, A., & Waterv., pf.	Q	1.5 %	Jan. 15
Manhattan Elec., com.	S	3 %	Feb. 1
Manhattan Elec., ex.		5 %	Feb. 1
Mil. Elec. Ry. & Lt., pf.	Q	1.5 %	Jan. 31
Montreal Tramways	Q	2.5 %	Feb. 1
Pub. Serv. Inv., pf.	Q	$1.50	Feb. 1
West Penn. Rys., pf.	Q	1.25%	Feb. 1

Reports of Earnings.

WESTERN UNION TELEGRAPH COMPANY.

The Western Union Telegraph Company has issued a report for the year ended December 31, 1915 (December estimated), which compares as follows:

	1915	1914
Total revenue	$52,356,286	$47,463,952
Maintenance, repairs and restoration, for depreciation	8,516,092	8,434,586
Operating expenses, taxes, etc.	32,286,225	32,320,729
Total expenses	40,802,317	40,755,315
Balance	11,553,969	6,708,637
Interest	1,335,588	1,337,242
Net income	*10,218,381	5,371,395

*Equal to 10.24 per cent earned on $99,786,759 capital stock against 5.17 per cent earned on same stock previous year.

AMERICAN TELEPHONE & TELEGRAPH COMPANY.

The American Telephone & Telegraph Company and associated, holding and operating companies in the United States, not including connected independent or sub-licensed companies, reports for the eleven months ended November 30, 1915, partly estimated, compared as follows:

	1915	1914
Gross earnings	$218,551,503	$206,710,452
Expenses	158,131,835	152,884,148
Net	$ 60,419,668	$ 53,826,304
Interest	16,670,957	17,341,567
Surplus	$ 43,748,711	$ 36,484,737
Dividends	29,978,831	27,767,324
Surplus	$ 13,769,880	$ 8,717,413

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

	Jan. 17	Jan. 10
American Tel. & Tel. (New York)	127½	127⅞
Commonwealth Edison (Chicago)	144	144
Edison Electric Illuminating (Boston)	243	247
Electric Storage Battery common (Philadelphia)	64	66½
Electric Storage Battery preferred (Philadelphia)	64	66½
General Electric (New York)	175¾	173⅞
Kings County Electric (New York)	128	128
Massachusetts Electric common (Boston)	6½	5½
Massachusetts Electric preferred (Boston)	34	34
National Carbon common (Chicago)	165	165
National Carbon preferred (Chicago)	121	121
New England Telephone (Boston)	131½	132
Philadelphia Electric (Philadelphia)	28	28⅝
Postal Telegraph and Cables common (New York)	78¼	78½
Postal Telegraph and Cables preferred (New York)	66	66¼
Western Union (New York)	91¼	88⅛
Westinghouse common (New York)	67¼	68
Westinghouse preferred (New York)	76½	77

PERSONAL MENTION.

MR. A. S. LINDSTROM, representing the Thorgarson Electric Company, which had an exhibit in the Palace of Machinery at the Panama-Pacific Exposition, has opened an office in the Rialto Building, San Francisco.

MR. F. H. BETHELL, vice-president of the New York Telephone Company, has been elected a director of the Liberty National Bank, of New York City; and MR. FORD HUNTINGTON, also vice-president of the New York Telephone Company, has been elected a director of the Coal & Iron National Bank, of New York City.

MR. W. F. HOLT, who established the public utilities in the Imperial Valley, has disposed of his electric power plants, transmission lines and electric railway in the Imperial and Coachella valleys to the Southern Sierras Power Company of Riverside, Cal. The deal involved a momentary consideration of approximately $1,500,000.

MR. F. S. BURROUGHS, former chief engineer of the Washington Public Service Commission, has been employed by Corporation Counsel James E. Bradford as an expert engineer to assist in resisting the petition of the Puget Sound Traction, Light & Power Company of Seattle to be relieved of certain of its franchise requirements.

MR. J. ROWLAND MIX, former business manager of *Scribner's Magazine*, announces that he has opened an office at 16 East Thirty-third Street, New York City, to conduct a general advertising business. Mr. Mix has had exceptional opportunities for acquiring an intimate knowledge of the most effective advertising methods, as well as the best mediums. His wide circle of friends will one and all extend best wishes to him in his new field of work.

MR. L. H. CLARK, son of E. L. Clark, president of the Valentine-Clark Company, Minneapolis, Minn., one of the oldest concerns in the cedar pole business, was married on the evening of January 12, 1916, at Christ Church, St. Paul, to Miss Lucile Janette Beck, of St. Paul. Mr. Clark is a member of the firm of Valentine-Clark Company, and his many cedar friends from various parts of the country were present at the wedding. Mr. and Mrs. Clark are at present enjoying their honeymoon and on their return they will make their home at 3037 Knox Avenue South, Minneapolis.

MR. CHESTER A. GAUSS, who was recently appointed publicity manager of the Crocker-Wheeler Company, Ampere, N. J., is a 1912 electrical-engineering graduate of Lehigh University. Following his college work he served for several months in the testing department of the General Electric Company at Schenectady, N. Y., and later became one of the technical writers on the publicity staff of that company. In 1914 he was on the editorial staff of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN and is well remembered by his former associates. Following some text-book editing for the American School of Correspondence, he joined the editorial staff of the *Electrical World*, from which he resigned to assume his present responsibility.

MR. W. B. PIERCE, for the past six years connected with the Western Electric Company, Chicago, has accepted a position with the Hughes Electric Heating Company, Chicago, to take charge of sales in the New England territory, with

headquarters at Boston, Mass. Mr. Pierce has had a wide experience in the electrical industry having been engaged in sales and promotion work continuously for 12 years. While with the Western Electric Company he was in direct charge of appliance sales and in this capacity inaugurated many noteworthy campaigns. He is particularly fitted for his new work and brings to the Hughes organization a fund of selling ideas and experience that will be of inestimable value in gaining greater recognition for Hughes heating and cooking appliances in the northeast.

OBITUARY.

MR. ALEXANDER W. MacDONALD, one of the founders of *Scientific American*, and one of the oldest editors in the country, died January 13, aged 93 years.

DR. JOSIAH SWEET, aged 60, one of the leading physicians of Litchfield County, Conn., and for many years coroner for the towns of New Hartford and Barkhamsted, died from pneumonia at his home in New Hartford, on January 13. He was president of the New Hartford Electric Light Company. He left a widow and three sons.

MR. FLORENTINE J. MACHALSKE analytical electrochemist, was found dead in his room in Plattsburg, N. Y., of heart disease on January 16. Since November, 1912, he had been experimenting with a new electrical process for manufacturing steel. In a statement made by him recently he declared he had a process virtually perfected that would entirely revolutionize the steel industry. He was a member of many scientific societies.

DATES AHEAD.

Western Association of Electrical Inspectors. Eleventh annual meeting, Hotel Sherman, Chicago, January 25-27. Secretary, W. S. Boyd, 175 West Jackson Boulevard, Chicago, Ill.

Electrical Contractors' Association of the State of Illinois. Semi-annual convention, Hotel Sherman, Chicago, Ill., January 27 and 28. Secretary, M. Blumenthal, 179 West Washington Street, Chicago, Ill.

American Electric Railway Association. Midyear meeting, Congress Hotel, Chicago, Ill., February 4. Secretary, E. R. Burritt, 8 West Fortieth Street, New York City.

American Institute of Electrical Engineers. Midwinter convention, New York City, February 8 and 9. Secretary, F. L. Hutchinson, 33 West Thirty-ninth Street, New York City.

Illuminating Engineering Society. Midwinter convention, New York City, February 10 and 11. Assistant secretary, Joseph Langan, 29 West Thirty-ninth Street, New York City.

New Mexico Electrical Association. Annual convention, Albuquerque, N. M., February 14-16. Secretary, E. A. Thiele, Roswell, N. M.

Electrical Supply Jobbers' Association. Quarterly meeting, Hotel Statler, Detroit, Mich., February 15-17. Secretary, F. Overbagh, 411 South Clinton Street, Chicago, Ill.

New England Section, National Electric Light Association. Question-Box convention, Boston, Mass., March 8 and 9. Secretary, Miss O. A. Bursiel, 149 Tremont Street, Boston, Mass.

Wisconsin Electrical Association. Annual convention, Hotel Pfister, Milwaukee, Wis., March 16 and 17. Secretary, George Allison, First National Bank Bldg., Milwaukee, Wis.

Record of Electrical Patents

Issued by the United States Patent Office, January 11, 1916

Prepared by Thomas Howe, Patent Attorney, 2 Rector Street, New York, N. Y.

1,167,378. **Ground-Terminal Connection for Electric Conductors.** L. B. Buchanan, Woburn, Mass. For clamping conductor to water pipes and the like.

1,167,382. **System of Electrical Distribution.** F. Castiglionli, Wilmette, Ill. Combination of direct-current traction systems, at different elevations.

1,167,389. **Generator Suspension.** R. M. Dixon, assignor to the Safety Car Heating & Lighting Co., Newark, N. J. From car truck.

1,167,411. **Circuit-Breaker.** S. H. Keefer, assignor to Niles-Bement-Pond Co., Jersey City, N. J. Adjustable, time-limit device.

1,167,423. **Annunciator for Checkers and Similar Games.** A. Nelson, St. Paul, Minn. Lamps in compartments of device simulating checker board are suitably controlled.

1,167,456. **Ignition System for Internal-Combustion Engines.** H. C. Well, New York, N. Y., assignor of fifty-one-hundredths to F. A. B. Meinhardt, New York, N. Y. Spark plug circuit made and broken by sleeve in cylinder rotated from piston rod.

1,167,473. **Lamp Clamping Socket.** R. B. Benjamin, assignor to Benjamin Electric Co., Chicago, Ill. Insulating body has internal flange laterally supporting clamp for lamp base.

1,167,474. **Attachment-Plug.** R. B. Benjamin, assignor to Benjamin Electric Co. Details of two-part plug.

1,167,481. **Fusible-Link Heater.** E. T. Copeland, New York, N. Y. Link has two separable members, one of which carries removable electric heating unit.

1,167,483. **Ignition System.** B. Dick, assignor to Wagner Electric Mfg. Co., St. Louis, Mo. Special arrangement of cam-operated and vibratory interrupters.

1,167,484. **Production of Nickel Hydroxid.** T. A. Edison, assignor to Edison Storage Battery Co., West Orange, N. J. For use in alkaline storage batteries, is precipitated from solution of a nickel salt.

1,167,485. **Storage Battery.** T. A. Edison, assignor to Edison Storage Battery Co. Cerium oxid is active material of depolarizing element of alkaline storage battery.

1,167,486. **Starter for Induction Motors.** P. R. Ellguths, Chicago, Ill. Automatic switch controlling windings of single phase motor having starting winding.

1,167,499. **Primary Battery.** W. E. Holland, assignor to New Jersey Patent Co., West Orange, N. J. Structure of zinc electrode plate.

1,167,501. **Phonographic Apparatus.** N. H. Holland, assignor to New Jersey Patent Co. Automatic control of electrically-driven record and electrically-operated sound box.

1,167,522. **Electromechanical Selecting Mechanism for Telephones.** C. Richardson, Boston, Mass. For party lines.

1,167,546. **Automobile Tail Lamp.** M. B. Danheiser, Huntsville, Ala. Colored translucent plate moved in front of lamp and out of light path electrically controlled by gear shift.

1,167,532. **Process of Manufacturing Tungsten Anticathodes for Rontgen Tubes.** O. A. Simpson, assignor to Siemens & Halske, A. G., Berlin, Germany. Annular piece of tungsten, formed from powdered tungsten is melted and welded to end of drawn tungsten rod.

1,167,579. **Lamp Socket.** A. C. Williams, South Bend, Ind. Details of film socket.

1,167,583. **Safety Device for Moving Picture Machines.** C. F. Mehl, H. B. Liebler, J. Nall and E. J. Nobbe, Cleveland, Ohio. Details of film drive controlling electric circuit.

1,167,594. **Electrolytic Cell.** L. E. Porter, Los Angeles, Cal., assignor to H. E. Stock, Casper, Wyo. Structural details of device having anodes inside cylindrical cathode.

1,167,601. **Electrically Operated Sound Producer.** C. J. Schwarze, assignor to Schwarze Electric Co., Adrian, Mich. Electromagnetic vibrator beats diaphragm.

1,167,602. **Escalator Controlling System.** W. C. Strang, assignor to Otis Elevator Co., New York, N. Y. Has plurality of motors, either of which may be connected to driving shaft.

1,167,606. **Switch Mechanism.** A. Wendleburg, assignor to Pittsburgh Electric Tool Co., New York, N. Y. Details of full operated switch for electric tools, etc.

1,167,608. **Electric Coupling for Cars.** P. Winsor, Weston, and C. Corliss, Boston, Mass. Corresponding conductors are connected regardless of end for end relation of cars.

1,167,613. **Electrically Heated Radiator.** P. F. Apfel, Seattle, Wash. Contains body of oil in which heating element is immersed.

1,167,631. **Trolley Wheel.** J. E. Crook, Chicago, Ill. Has hollow bearing to facilitate lubrication.

1,167,646. **Machine Telephone Switching System.** F. B. McBerty, assignor to Western Electric Co., New York, N. Y. Special arrangement of impulse-controlled, power-driven selector switches.

1,167,654. **Self-Induction Coils for Duplex Telephone Connections According to the Pupin System.** A. H. Olsson and H. B. M. Pleijel, Stockholm, Sweden. Two double loading coils in two double lines are laid together and loading produced by leakage flux between them.

1,167,657. **Indicator.** J. V. Potter, Louisville, Ky. Four vehicles; lever mechanism selectively throws sign plates in front of light.

1,167,663. **Pulsation Device for Musical Instruments.** G. B. Sinclair and G. I. Fiske, assignors to Choralcelo Mfg. Co., Boston, Mass. Pulsators electromagnetically connected with sonorous bodies.

1,167,677. **System for Measuring Capacities.** G. A. Campbell, O. B. Blackwell and E. H. Colpitts, assignors to American Telephone & Telegraph Co., New York, N. Y. For determining capacities between the elements of phantom circuits.

1,167,680. **Automatic Generator.** J. B. Dalbey, Nevada, Iowa. Electric igniting apparatus on fuel burner.

1,167,681. **Spinning Device.** H. Evans, Lewiston, Me. Relative speeds of bobbins electrically controlled by slack thread.

1,167,693 and 1,167,694. **Artificial Line.** R. S. Hoyt, assignor to American Telephone & Telegraph Co. First patent: For simulating impedance of actual loaded line. Second patent: For simulating impedance of actual uniform transmission line.

1,167,700. **Process of Extracting Zinc from its Ores.** F. Laist and F. Frick, Anaconda, Mont. Cyclical process of extracting zinc from sulfid ores containing iron.

1,167,701. **Process of Recovering Zinc from its Ores.** F. Laist, and F. Frick. Modification of above.

1,167,705. **Cathode for Electrolytic Cells.** F. McDonald, Roaring Springs, Pa. Structure and mounting of graphite plate.

1,167,707. **Portable Self-Contained Electric Lamp.** F. W. Mebold, St. Louis, Mo. Attached to terminals of dry battery.

1,167,720. **Machine for Winding Coils.** A. D. Scott, assignor to Varley Duplex Magnet Co., Jersey City, N. J. Details of machine for winding magnet coils.

1,167,721 and 1,167,723. **Mandrel for Winding Coils.** A. D. Scott, assignor to Varley Duplex Magnet Co. First patent: Expansible and contractible winding mandrel. Second patent: Has special wire guiding devices.

1,167,722. **Method of Winding and the Product Thereof.** A. D. Scott, assignor to Varley Duplex Magnet Co. Special disposition of turns and layers in magnet coils.

1,167,740. **Method of Controlling the Humidity of Air Under Pressure.** W. H. Carrier, assignor to Buffalo Forge Co., Buffalo, N. Y. Comprises electric heating arrangements.

1,167,749. **Electric Heating Apparatus.** W. S. Hadaway, Jr., New Rochelle, N. Y. Rod carrying resistor has attachment plug at one end.

1,167,750. **Electric Heater for Laundry Rolls.** W. S. Hadaway, Jr. Armored heater units extend into roll from plate secured to one end of it.

1,167,760. **Lineman's Tool.** S. Jones, Newark, N. J. Cable gripping device.

1,167,762. **Ignition System.** C. F. Kettering, assignor to Dayton Engineering Laboratories Co., Dayton, Ohio. Combination battery and magneto arrangement.

1,167,772. **Third-Rail Support.** J. C. McGovern, and M. Cohen, South San Francisco, Cal. Attached to main rail.

1,167,780. **Connector.** E. Q. Moses, New York, N. Y., assignor of one-half to W. P. Hammond, Passaic, N. J. Conductor terminal comprising spring clip for attachment to binding posts of batteries, etc.

1,167,804. Spark-Plug. A. A. Edey, Mobile, Ala. Cap for the spark points.

1,167,810. Storage-Battery Jar. B. Ford, Philadelphia, Pa. Special structure of cover to form tight closure. (See cut.)

1,167,815. Automatic Valve. E. E. Gold, assignor to Gold Car Heating & Lighting Co., New York, N. Y. Electromagnetically operated.

1,167,820. Electric Cable Terminal. G. L. Herz, Vienna, Austria-Hungary. For attachment to spark plugs, etc.

1,167,821. Signal for Motor Cars. A. Holtz, Detroit, Mich. Automobile direction indicator; lamp operated by and mounted on arm on rock shaft.

1,167,839. Automatic Control for Ignition Devices. L. T. Rhoades, assignor to New York Coil Co., New York, N. Y. Thermostat opens circuit when timer stops with contacts together.

1,167,857. Photographic Printing Machine. E. A. Thorberg, Bismarck, N. D. Casing provided with battery, lamp, reflector, negative holder, etc.

1,167,868. Rheostat. G. M. Willis, assignor to Chicago Electric Meter Co., Chicago, Ill. Arrangement of contact clip sliding along resistor element.

1,167,872. Electromechanical Exchange System. F. G. Agrell, Stockholm, Sweden. Special circuit arrangements in system of character indicated.

1,167,878. Portable Electric Light. B. Benedict, assignor to Beacon Miniature Electric Co., New York, N. Y. Casing conforming to dry battery which it contains fitted with lamp, switch, reflector, etc.

1,167,879. Switch Box. J. Z. Bayliss, and C. Raus, Cleveland, Ohio. Gang outlet box.

1,167,880. Electrical Switch Mounting. J. A. Bennan, Chicago, Ill. Sheet metal structure for battery boxes, etc.

1,167,890. Electric Motor. F. S. Denison, assignor to Minneapolis Heat Regulator Co., Minneapolis, Minn. Has thermostatic control and automatic limit devices.

1,167,891. Electric Light Shifter. W. H. Eisenhart, York, Pa. Adjustable electric light bracket.

1,167,904. Apparatus for Treating Box Toe Pieces. W. A. Knipe and T. McKinney, Ward Hill, Mass. Electrically heated hand tool.

1,167,931. Electric Signal System. E. A. Reynolds and H. V. Reynolds, Anderson, Ind. For railway with electrically continuous track.

1,167,946. Starting and Accelerating Device for Motors. W. S. Smith, Cambridge, Mass. Electromagnetically-operated resistance controller.

1,167,949. Rigid Piece of Metal Insulated Against Electrolysis and Corrosion and the Process of Making the Same. P. M. Stewart, New York, N. Y., assignor of one-half to H. H. Robertson, Sewickley, Pa. and one-half to G. F. Stewart. Manner of covering structural steel shapes for purpose indicated.

1,167,961. Station Box for Watchman and Fire Alarm Signaling. F. Williams, assignor to Acme Register Co., Somerville, Mass. Central station has time and place recorders and signal stations send time and place signals simultaneously or independently.

1,167,962. Cable Splice. W. O. Wilson, Chicago, Ill. Manner of splicing lead covered cables.

1,167,964 and 1,167,965. Electrical Fuse. H. W. Young, Chicago, Ill. Cartridge fuses.

1,167,970. Internal Combustion Engine. R. J. Balz, Syracuse, N. Y., assignor of one-half to G. C. Meyer, Syracuse, N. Y. Base has battery chamber.

1,167,980. Indicator for Pneumatic Tires. S. F. Cole, Purcellville, Va. Circuit closed by decrease in air pressure in tire.

1,167,991. Illuminating Means for Telescope Cross Hairs. A. Grebe, assignor to Bausch & Lomb Optical Co., Rochester, N. Y. Particular arrangement of lamp socket and reflectors.

1,167,998. Process of Obtaining Metals Such as Lead or Zinc in an Electric Furnace. A. Helfenstein, Vienna, Austria-Hungary. Manner of obtaining metal vapors which comprises preheating before distillation and drawing of gases and vapors and also part of vapors in distillation zone.

1,167,999. Letter Opening Machine. E. T. Hender, Chicago, Ill. Mounting of electric motor for driving cutter.

1,168,003. Motor Controller. A. J. Horton, assignor to Cutler-Hammer Mfg. Co., Milwaukee, Wis. Resistance control of field and armature.

1,168,005. Electric Switch. C. J. Klein, assignor to Cutler-Hammer Mfg. Co. Snap switch mechanism for lamp socket. (See cut.)

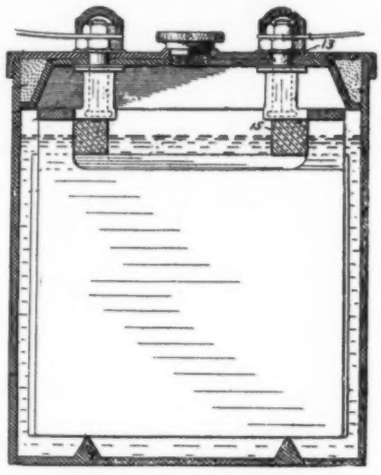
1,168,010. Automatic Train Control. J. Konsels, New York, N. Y., assignor of one-quarter to J. Havranek, New York, N. Y. Structure of wheel-operated contactor.

1,168,019. Pothead or Connector for Electrical Conductors. H. P. Liversidge, Pala, Pa. Comprises elements readily assembled and disassembled.

1,168,021. Brush Holder for Dynamo Electric Machines. C. B. Mills, assignor to Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa. Structure of sheet metal brush box and holder.

1,168,031. Suspension Type Insulator. K. C. Randall, assignor to Westinghouse Electric & Mfg. Co. An insulator composed of alternately disposed conducting and insulating bodies.

1,168,037. Magnetic Connection. F. Short, assignor to General Electric Co., Schenectady, N. Y. For securing shaft of speed indicator to end of revolving shaft.



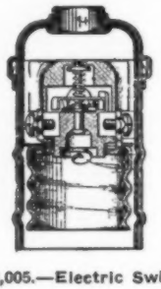
1,167,810.—Storage Battery Jar.

1,168,038. Control System. K. A. Simmon, and A. J. Hall, assignors to Westinghouse Electric & Mfg. Co. Rheostatic control of vehicle for acceleration and regeneration with provision for compensating for difference in diameters of wheels.

1,168,048. Motor Control System. H. L. Beach, assignor to Westinghouse Electric & Mfg. Co. Field resistance automatically controlled by current in dynamic braking circuit.

1,168,054. Electrical Protective Device. H. W. Brown, assignor to Westinghouse Electric & Mfg. Co. Rotative type relay has provision for regulating torque.

1,168,064. Search Light. V. Elsaesser, assignor to the firm of R. Bosch, Stuttgart, Germany. Relates to reflection and refraction.



1,168,005.—Electric Switch.

1,168,065. System for Distributing and Regulating Electrical Energy in the Form of Alternating Currents. W. M. Fairfax, Washington, D. C. Split phase motors operated from single phase circuit.

1,168,066. Switch-Lock. R. L. Girardot, Detroit, Mich. A cover is locked over key socket and fastenings of cover plate of switch casing.

1,168,074. Electric Resistance Material. M. A. Hunter, Troy, N. Y. Alloy of nickel, copper and chromium.

1,168,077. Incandescent Lamp with Concentrated Metallic Filament. H. J. Jaeger, Weehauken ,N. J. Filament mounting.

1,168,078. Terminal Seal for Batteries. E. W. Jefferson, Winnipeg, Manitoba, Can. Destructible dome encloses terminal to prevent discharge when not in use.

1,168,084. Illuminated Sign. H. F. Lowenstein, Washington, D. C., assignor of one-half to H. S. Hill, Washington, D. C. Displays designs selective by different colored rays.

1,168,090. Mechanical Horn. G. Marsico, New York, N. Y. Has diaphragm vibrated by electromagnet.

1,168,146. Electric Heater for Steering Wheels. G. H. Barnes, Dunham, Quebec, Canada. Flexible resistance heater pad laced to wheel rim.

1,168,170. Station Indicator. R. M. Craig, San Antonio, Tex. For vehicles; has electrically-driven and controlled band displaying street names.

1,168,177. Means for Labeling Radiographs. A. De Yoanna, New York, N. Y. Label of tin foil bears legend of different permeability to X-rays.

1,168,184. Circuit Closer. E. Flanagan, Philadelphia, Pa. Fire alarm signal comprising contacts adapted to be closed on dropping of fuse supported weight.

1,168,190. Electric Lamp Receptacle. G. A. Gauthier, assignor to Arrow Electric Co., Hartford, Conn. Structural details.

1,168,195. Circuit Closing Switch. W. Grunow, New York, N. Y. Switch opened and closed by horizontal momentum wheel moving up and down shaft.

1,168,227. Method and Means for Indicating Suspended Matter in Gases. W. A. Schmidt, assignor to International Precipitation Co., Los Angeles, Cal. For testing smoke, etc.; current between high tension electrodes in flue is measured.

1,168,241. Flash Light. B. Benedict, assignor to Beacon Miniature Electric Co., New York, N. Y. Details of switch.

1,168,247. Cut Out and Switch. J. J. Buero, Charleston, S. C. Comprises switch and fuse plugs with means for protecting from excess current at excessive voltage.

1,168,256. Means for Automatically Controlling the Speed of Railway Vehicles. F. T. Jones, assignor to Jones Safety Train Control System Co., Baltimore, Md. Car circuits controlled by contacts along trackway having time controlled connections.

1,168,258. Means for Insulating Lamp Sockets and the Like. M. Matson, assignor to Cutler-Hammer Mfg. Co., Milwaukee, Wis. Relates to insulating lining of cap and shell.

1,168,259. Telephone Exchange System. J. L. Wright, assignor to E. E. Clement, Washington, D. C. Message-registering system.

1,168,261. Commutator Bar. F. J. Baird, Cleveland, Ohio. Formed of two longitudinal parts, each comprising radical and longitudinal portions, the radial parts being recessed to receive conductor ends.

1,168,263. Automatic Load Adjuster. L. H. Flanders, assignor to Electric Storage Battery Co., Philadelphia, Pa. Regulation of storage-battery system.

Patents Expired.

The following United States electrical patents expired on January 17, 1916:

617,708. Conduit Electric Railway. R. W. Barkley, New York, N. Y.

617,714. Electric Condenser. C. S. Bradley, Avon, N. Y.

617,715. Enclosed Electric Switch. W. M. Brown, Johnstown, Pa.

617,726. Counting Mechanism of Electric Supply Motor Meters. S. Evershed, London, Eng.

617,783. Electromagnetic Home. T. R. Smith, Los Angeles, Cal.

617,793. Regulator for Constant-Current Dynamos. J. J. Wood, Ft. Wayne, Ind.

617,806. Electric Igniter for Explosive Engines. F. E. Canda, New York, N. Y.

617,837. Electric Railway System. E. B. W. Reichel, Berlin, Germany.

617,838. Electromagnet. M. Schiemann, Dresden, Germany.

617,839. Connection Counting Mechanism for Telephone Lines. C. E. Scribner, Chicago, Ill.

617,840. Lock-out Mechanism for Party Telephone Lines. C. E. Scribner, Chicago, Ill

617,842. Method of and Means for Deriving Polyphase Currents. H. A. Wagner, St. Louis, Mo.

617,853. Electric Signaling. J. P. Coleman, Edgewood Park, Pa.

617,854. Relay. J. P. Coleman, Edgewood Park, Pa.

617,858. Magneto Circuit Closer. J. E. Fuller, New York, N. Y.

617,886. Electrolytic Regning of Copper. E. A. Smith, Anaconda, Mont.

617,890 to 617,892. Telautograph. G. S. Tiffany, Highland Park, Ill.

617,903. Galvanic Battery. C. T. Richmond, Cleveland, O.

617,938. Electrical Alarm Matting. A. D. Risley, Richfield Springs, N. Y.

617,958. Electrical Apparatus for Firing, Lighting or Extinguishing Gas Burners at a Distance. P. L. Guyenot, Aix les Bains, France.

618,042. Galvanic Battery. J. D. Darling, Philadelphia, Pa.

618,043. Zinc Electrode. J. D. Darling, Philadelphia, Pa.